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ANNUAL REPORT

OF THE

BOARD OF REGENTS

OF THE

SMITHSONIAN INSTITUTION

SHOWING

THE OPERATIONS, EXPENDITURES, AND CONDITION
OF THE INSTITUTION

TO

JULY, 1885.

PART I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1886.

FORTY-NINTH CONGRESS, FIRST SESSION.

The following resolution was agreed to by the Senate, and concurred in by the House of Representatives, July 17, 1886:

Resolved by the Senate (the House of Representatives concurring therein), That there be printed of the last annual reports of the Smithsonian Institution and of the National Museum, in two octavo volumes, sixteen thousand extra copies of each, of which three thousand copies shall be for the use of the Senate, six thousand copies for the use of the House of Representatives, and seven thousand copies for the use of the Smithsonian Institution.

LETTER

FROM THE

SECRETARY OF THE SMITHSONIAN INSTITUTION,

ACCOMPANYING

The annual report of the Board of Regents of that Institution to the end of June, 1885.

JULY 17, 1886.—Ordered to be printed.

SMITHSONIAN INSTITUTION,
Washington, D. C., January 15, 1886.

To the Congress of the United States:

In accordance with section 5593 of the Revised Statutes of the United States, I have the honor, in behalf of the Board of Regents, to submit to Congress the annual report of the operations, expenditures, and condition of the Smithsonian Institution to July, 1885.

I have the honor to be, very respectfully, your obedient servant,

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

HON. JOHN SHERMAN,
President of the Senate, pro tem.
HON. JOHN G. CARLISLE,
Speaker of the House of Representatives.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION TO THE END OF JUNE, 1885.

SUBJECTS.

1. Proceedings of the Board of Regents for the session of January, 1885.

2. Report of the Executive Committee, exhibiting the financial affairs of the Institution, including a statement of the Smithson fund, and receipts and expenditures for the year 1885 (to July 1).

3. Annual report of the Secretary, giving an account of the operations and condition of the Institution for the year 1885 (to July 1), with the statistics of collections, exchanges, &c.

4. General appendix, comprising a record of recent progress in the principal departments of science, and special memoirs, original and selected, of interest to collaborators and correspondents of the Institution, teachers, and others engaged in the promotion of knowledge.

The report of the Assistant Director and Curators of the National Museum for the year 1885 (to July 1), will be published in a separate volume.

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THE SMITHSONIAN INSTITUTION.

MEMBERS EX OFFICIO OF THE "ESTABLISHMENT."

(January, 1885.)

GROVER CLEVELAND, President of the United States.
JOHN SHERMAN, President of the United States Senate.
MORRISON R. WAITE, Chief Justice of the United States.
THOMAS F. BAYARD, Secretary of State.
DANIEL MANNING, Secretary of the Treasury.
WILLIAM C. ENDICOTT, Secretary of War.
WILLIAM C. WHITNEY, Secretary of the Navy.
WILLIAM F. VILAS, Postmaster-General.
LUCIUS Q. C. LAMAR, Secretary of the Interior.
AUGUSTUS H. GARLAND, Attorney-General.
MARTIN V. MONTGOMERY, Commissioner of Patents.

REGENTS OF THE INSTITUTION.

(Full list given on the following page.)

OFFICERS OF THE INSTITUTION.

SPENCER F. BAIRD, *Secretary,*
Director of the Institution, and of the U. S. National Museum.

WILLIAM J. RHEES, *Chief Clerk.*

DANIEL LEECH, *Corresponding Clerk.*

REGENTS OF THE SMITHSONIAN INSTITUTION.

By the organizing act approved August 10, 1846, (Revised Statutes, title LXXIII, section 5580,) "The business of the Institution shall be conducted at the city of Washington by a Board of Regents, named the Regents of the Smithsonian Institution, to be composed of the Vice-President, the Chief Justice of the United States [and the Governor of the District of Columbia], three members of the Senate, and three members of the House of Representatives, together with six other persons, other than members of Congress, two of whom shall be resident in the city of Washington, and the other four shall be inhabitants of some State, but no two of the same State."

REGENTS FOR THE YEAR 1885.

	Term expires.
The Vice-President of the United States:	
JOHN SHERMAN (elected President of Senate Dec. 7, 1885).	
The Chief Justice of the United States:	
MORRISON R. WAITE.	
United States Senators:	
SAMUEL B. MAXEY (appointed May 19, 1881)	Mar. 3, 1887
JUSTIN S. MORRILL (appointed February 21, 1883)	Mar. 3, 1891
SHELBY M. CULLOM (appointed March 23, 1885)	Mar. 3, 1889
Members of the House of Representatives:	
OTHO R. SINGLETON (appointed January 7, 1884)	Dec. 23, 1885
WILLIAM L. WILSON (appointed January 7, 1884)	Dec. 23, 1885
WILLIAM W. PHELPS (appointed January 7, 1884)	Dec. 23, 1885
Citizens of Washington:	
JAMES C. WELLING (appointed May 13, 1884)	May 13, 1890
MONTGOMERY C. MEIGS (appointed Dec. 26, 1885)	Dec. 26, 1891
Citizens of a State:	
JOHN MACLEAN, of New Jersey (first appointed in 1868)	Dec. 26, 1891
ASA GRAY, of Massachusetts (first appointed in 1874)	Dec. 26, 1891
HENRY COPPÉE, of Pennsylvania (first appointed in 1874)	Dec. 26, 1891
NOAH PORTER, of Connecticut (appointed in 1878)	Mar. 3, 1890

MORRISON R. WAITE, Chancellor of the Institution and *President of the Board of Regents.*

Executive Committee of the Board of Regents

JOHN MACLEAN. JAMES C. WELLING. HENRY COPPÉE.

JOURNAL OF PROCEEDINGS OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION.

WASHINGTON, D. C., *January* 21, 1885.

The annual meeting of the Board of Regents of the Smithsonian Institution was held this day at half past 10 o'clock A. M.

Present: Hon. G. F. EDMUNDS, Hon. J. S. MORRILL, Hon. S. B. MAXEY, Hon. O. R. SINGLETON, Hon. W. L. WILSON, Hon. W. W. PHELPS, Rev. Dr. JOHN MACLEAN, Rev. Dr. NOAH PORTER, Dr. HENRY COPPÉE, Dr. JAMES C. WELLING, and the Secretary, Professor BAIRD.

Excuses for non-attendance were read from Chief-Justice Waite, Prof. Asa Gray, and Hon. N. P. Hill.

In the absence of the Chancellor, on motion of Mr. Phelps, Dr. PORTER was called to the chair.

The journal of the Board was read and approved.

The Secretary stated that the Rev. Dr. NOAH PORTER had been re-elected a Regent for six years by the joint resolution of Congress, approved March 3, 1884.

The Secretary presented to the Board the following letter:

Prof. SPENCER F. BAIRD,
Secretary of the Smithsonian Institution:

DEAR SIR: The state of my health renders it necessary to tender my resignation as a member of the Board of Regents of the Smithsonian Institution.

In signifying my resignation it is with no ordinary feelings I recall the years I have been connected with the Board and the distinguished men with whom it has been my privilege and honor to be associated. Not only the present members whom I so highly respect and esteem, but a long list of honored names of former members now deceased, recur to me, the last of which is that of Professor JOSEPH HENRY, and while JAMES SMITHSON will be known to the world and remembered as the founder of the Institution, JOSEPH HENRY will be regarded as having been raised up by a signal Providence, the true interpreter of his will, the able organizer of the Institution, and wise controller of its finances.

May the Smithsonian Institution, so auspiciously established and extensively known, continue, under your wise administration, an establishment *distinct* and *specific*, for the "increase and diffusion of knowledge among men."

With great respect, your friend and servant,

PETER PARKER.

2 LAFAYETTE SQUARE,
Washington, D. C., April 7, 1884.

The Secretary informed the Board that Congress had filled the vacancy occasioned by the resignation of Dr. Parker by the election of Dr. JAMES C. WELLING, president of Columbian University of Washington, D. C., for six years from May 13, 1884.

On motion of Dr. Maclean it was—

Resolved, That the Board of Regents has heard with regret of the resignation of Dr. Peter Parker, and hereby expresses the high appreciation of the valuable and efficient services he has rendered the Institution for the past seventeen years as a Regent and as Chairman of its Executive Committee.

The Secretary stated that in accordance with the rules of the Board during its recess, the remaining members of the Executive Committee had filled the vacancy occasioned by the resignation of Dr. Parker, by the appointment of Dr. Welling.

On motion of Dr. Coppée it was—

Resolved, That Dr. Welling be elected to fill the vacancy in the Executive Committee.

The Secretary reported that in accordance with the request of the Board at its last meeting, Senator Edmunds had prepared a bill relative to the provision for an Acting Secretary, which had passed Congress and become a law on the 13th of May, 1884, as follows:

An act to provide for the appointment of an Acting Secretary of the Smithsonian Institution.

[Public No. 31, Forty-eighth Congress, first session.]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Chancellor of the Smithsonian Institution may, by an instrument in writing filed in the office of the Secretary thereof, designate and appoint a suitable person to act as Secretary of the Institution when there shall be a vacancy in said office, and whenever the Secretary shall be unable from illness, absence, or other cause to perform the duties of his office; and in such case the person so appointed may perform all the duties imposed on the Secretary by law until the vacancy shall be filled or such inability shall cease. The said Chancellor may change such designation and appointment from time to time as the Institution may in his judgment require.

Approved, May 13, 1884.

Under the provisions of this act the Chancellor had taken the following action:

LYME, CONN., *July* 2, 1884.

By virtue of the authority conferred on me by the act of May 13, 1884, "to provide for the appointment of an Acting Secretary of the Smithsonian Institution," I hereby designate and appoint Mr. WILLIAM J. RHEES to act as Secretary of the Institution when there shall be a vacancy in that office, and whenever the Secretary shall be unable from illness, absence, or other cause to perform the duties of his office.

M. R. WAITE,
Chancellor of the Smithsonian Institution.

Dr. Maclean presented the annual report of the Executive Committee, which was read.

On motion of Dr. Coppée it was—

Resolved, That the report of the Executive Committee be accepted, and that the income for the year 1885 be appropriated for the service of the Institution upon the basis of the above report, to be expended by the Secretary with full discretion as to the items, subject to the approval of the Executive Committee.

The Secretary presented the following communication he had received since the last meeting of the Board:

JUNE 2, 1884.

SPENCER F. BAIRD,
Secretary Smithsonian Institution,
Washington, D. C.:

SIR: I intend to make a bequest for the advancement of science—that is, of physical science. For many reasons I would like to make the bequest in favor of the Smithsonian Institution; but there is one difficulty which must be cleared up before I can decide. If money were left by will to the Smithsonian Institution would it defend the will against the claims of any and all persons who should contest the will and take legal steps to set it aside? Has it authority by law; has it funds that it would be authorized to use for the purpose of defending a will in its favor? As I have no children the will would be less likely to be contested, but there are others who might attempt to set it aside. For this reason what I wish above all to be assured of, is that any legacy that I leave for the purpose named will not be given up without making a fight of it if needful. Please explain this point.

I wish you to send me a form of words, the very words themselves, in which a bequest should be made so that there could be no pretense of setting it aside for vagueness; and that will carry out my intentions, which I will explain:

The chief part I would desire to bequeath to the Institution would be for the "increase and diffusion of knowledge among men," and beside would wish to have the Institution invest say $300 (is that too insignificant for the purpose?) and use the income thereof for conferring a gold medal either annually or biennially (which would be the better?) on the person who had made the most important discovery in physical science during the year, or two years, ending, say a year before the date of conferring the medal. For example, the Regents would have to decide, say in the month of December, 1883, who made the most important discovery in physical science during the year, or two years, ending December 31, 1882. If you have my meaning put it in language that will make it perfectly clear without multiplying words.

The medal not for any patented invention, like the electric light, for example, but especially and only for such discoveries as Pasteur on infection, fermentation, &c., and G. Darwin's on tidal action. Regents to be sole judges as to what is meant by physical science and most important discoveries therein.

The reason why I would like to have not only suggestions and explanations but the full "I will and bequest to" is also because I don't know whether to say the Regents shall do this or that, or whether to say a majority or quorum of them shall do it in order to make it both strictly legal and also practicable; also, whether or not it is necessary to say how the Regents shall invest the money. I suppose a copy of that part of Hamilton's or Huebus' (Habel?) will would answer for the part relating to the "increase and diffusion," &c. As for the medal I believe no fund has been left to institutions for that purpose, and I should like to have your opinion on it.

Please return this letter with your answer, which I would like you to let me have as soon as you can; taking, however, all the time you need to make it so full and explicit that no further correspondence will be necessary at this stage. I mean business if your answer is satisfactory. For the present I desire this affair to be treated as confidential, or if necessary to mention to other parties, withhold the name.

There is one thing I had rather do than make a bequest in favor of the Institution, namely, pay over a certain sum, say $2,000 or $2,500, in trust to the Regents; provided I could receive the income during life, the Institution to have the sole use and possession of the same after my death. Would the Institution be authorized to accept a sum of money on such terms?

Respectfully,

* * * *

After full discussion of the subject it was, on motion of Mr. Edmunds—

Resolved, That the communication be referred to the Executive Committee with full power to act in relation to it.

The Secretary, Professor Baird, presented his annual report of the operations of the Institution for the year 1884, which was read in part.

On motion of Dr. Maclean, the Secretary was instructed to transmit the report to Congress.

On motion of Mr. Edmunds, it was—

Resolved (1), That the fiscal year of the Institution shall hereafter terminate on the 30th day of June in each year.

(2) That the Secretary shall hereafter prepare and cause to be printed and sent to each member of the Board on or before the first day of December in each year, his annual report.

(3) That the annual meeting of the Board of Regents shall hereafter be held on the second Wednesday in January in each year.

The Board then adjourned *sine die.*

REPORT OF THE EXECUTIVE COMMITTEE OF THE BOARD OF REGENTS OF THE SMITHSONIAN INSTITUTION.

The Executive Committee of the Board of Regents of the Smithsonian Institution respectfully submits the following report in relation to the funds of the Institution, the appropriations by Congress for the National Museum and other purposes, and the receipts and expenditures for the Institution and the Museum since December 31, 1884.

At the last meeting of the Board of Regents (January 21, 1885) it was ordered that "the fiscal year of the Institution shall hereafter terminate on the 30th day of June in each year."

In accordance with this action it becomes the duty of the Executive Committee to confine its present report to the financial operations and condition of the Institution, for the six months ending June 30, 1885:

Condition of the fund July 1, 1885.

The amount of the bequest of James Smithson deposited in the Treasury of the United States, according to the act of Congress of August 10, 1846, was $515,169. To this was added, by authority of Congress, act of February 8, 1867, the residuary legacy of Smithson and savings from annual income and other sources, $134,831. To this $1,000 was added by a bequest of James Hamilton, $500 by a bequest of Simeon Habel, and $51,500 as the proceeds of the sale of Virginia bonds owned by the Institution, making, in all, as the permanent Smithson fund in the United States Treasury, $703,000.

Statement of the receipts and expenditures of the Smithsonian Institution, January 1, 1885, *to June* 30, 1885.

Cash on hand January 1, 1885 .... $25, 380 84

EXPENDITURES.

Building:		
Repairs and improvements	$314 90	
Furniture and fixtures	237 25	
		$552 15

Building expenses brought forward		$552 15	$25,380 84
General expenses:			
Meetings of the Board	$347 25		
Postage and telegraph	202 28		
Stationery	407 45		
General printing, blanks, &c	91 30		
Incidentals, gas, &c	408 79		
Books, periodicals, binding	779 33		
Salaries, Secretary, clerks, and labor	9,180 67		
		11,417 07	
Publications and researches:			
Smithsonian Contributions to Knowledge	2,367 65		
Smithsonian miscellaneous collections	2,631 01		
Smithsonian annual report	775 12		
Explorations	1,522 18		
Apparatus	151 25		
		7,447 21	
Literary and scientific exchanges (in addition to appropriation by Congress)		3,307 59	
Total expenditures			22,724 02
Balance on hand			2,656 82
Interest on the Smithson fund for six months ending June 30, 1885			21,090 00
Total cash on hand July 1, 1885			$23,746 82

NATIONAL MUSEUM AND OTHER OBJECTS COMMITTED BY CONGRESS TO THE CARE OF THE SMITHSONIAN INSTITUTION.

The following appropriations were made at the second session of the Forty-eighth Congress for the National Museum and other objects committed to the care of the Smithsonian Institution:

For the preservation and exhibition and increase of the collections received from the surveying and exploring expeditions of the Government, and other sources, including salaries or compensation of all necessary employés	$95,000 00	
For expenses of heating, lighting, and telephonic and electrical service for the new Museum building	9,000 00	
		$104,000 00
For care of the Armory building and grounds, and expense of watching, preservation, and storage of the property of the National Museum and of the United States Fish Commission contained therein, including salaries or compensation of all necessary employés		2,500 00

For cases, furniture, and fixtures required for the exhibition of the collections of the United States National Museum, and for salaries or compensation of all necessary employés	$40,000 00
For expenses of the system of international exchanges between the United States and foreign countries, under the direction of the Smithsonian Institution, including salaries or compensation of all necessary employés	10,000 00
For finishing and completing the furnishing of the eastern portion of the Smithsonian Institution building	5,600 00
For the purpose of continuing ethnological researches among the American Indians, under the direction of the Secretary of the Smithsonian Institution, including salaries or compensation of all necessary employés	40,000 00
To pay sundry bills for miscellaneous fixtures and for glass for exhibition cases for the National Museum, being for the service of the fiscal year ending June 30, 1884	2,891 42
To meet expenses of receiving, packing, transporting to Washington, and installing, or storing, such new specimens and collections as may be presented to the United States at the New Orleans Exposition, to be available for the fiscal years ending June 30, 1885 and 1886	5,000 00
For cost of restoring the collections sent to the New Orleans Exposition to their proper places in the National Museum, including repair of cases and renewal of glass, to be available for the fiscal years ending June 30, 1885 and 1886	2,500 00

Exhibit of the condition of the appropriations by Congress for the Smithsonian Institution, National Museum, &c.

Object.	Balances January 1, 1885.	Expended January 1 to June 30, 1885.	Balances July 1, 1885.
SMITHSONIAN INSTITUTION.			
Fire-proofing, &c., eastern portion of building	$1,298 22	$1,298 22	....
International exchange system	5,794 50	5,794 50	....
North American ethnology	19,525 62	18,166 70	$1,358 92
NATIONAL MUSEUM.			
Preservation of collections	53,399 27	48,543 71	4,855 56
Armory building	1,500 50	1,492 25	8 25
Furniture and fixtures	12,636 36	10,849 96	1,786 40
Paving sidewalk for Museum	1,000 00	....	1,000 00

The committee has examined the vouchers for payments made from the Smithson income during the six months ending 30th June, 1885, all of which bear the approval of the Secretary of the Institution, and a certificate that the materials and services charged were applied to the purposes of the Institution.

The committee has also examined the accounts of the National Museum and find that the balances above given correspond with the certificates of the disbursing officers of the Interior and Treasury Departments.

The quarterly accounts-current, the vouchers, and journals have been examined and found correct.

Respectfully submitted.

JOHN MACLEAN,
JAMES C. WELLING,
HENRY COPPÉE,
Executive Committee.

REPORT OF PROFESSOR BAIRD,

SECRETARY OF THE SMITHSONIAN INSTITUTION, FOR 1885.

To the Board of Regents:

GENTLEMEN: In accordance with the resolution of the Board at the last meeting directing that the fiscal year, instead of extending from January to December, shall correspond with the Government fiscal year, and extend from July to the following June, inclusive, the present report will include the history of the operations of the Institution for the first half of 1885 only. The same restrictions in regard to time will apply to the reports of the National Museum, the Bureau of Ethnology, and the system of International Exchanges which have been placed by Congress under the direction of the Institution. As heretofore, there will also be some account of the operations of the United States Fish Commission, and those of the Geological Survey, which, although not controlled in any way by the Institution, are so closely affiliated with it as to render proper some notice of them.

SMITHSONIAN INSTITUTION.

INTRODUCTORY.

The general routine work of the Institution continues to be much the same as in previous years, and while no specially new features have been introduced, considerable extension has been made in some departments, and increased precision and efficiency in all. In the way of extra duty the principal occasion has been the International Exposition at New Orleans, where the Institution (by requirement of law) made a very extensive display.

The new work on the eastern portion of the Smithsonian building has been entirely finished, and much progress made in renovating the central portion.

A considerable number of valuable publications have appeared, and others are in press.

The work of the Museum continues to increase in magnitude, much material having been received from the New Orleans Exposition.

THE BOARD OF REGENTS.

It is with great regret that I announce the termination of service on the Board, of General William T. Sherman, his term having expired and his removal from Washington to Saint Louis, Mo., rendering him ineligible for re-election, the law of organization requiring two members of the Board to be citizens of the District of Columbia. Dr. Welling, president of Columbian University, is the only member from this city at present, he having been elected by Congress at its last session a Regent for six years, until May 13, 1890.

The term of service of an unusually large number of Regents will expire during the winter of 1885–1886. As "members at large," Rev. Dr. John Maclean, of New Jersey, Prof. Asa Gray, of Massachusetts, and Dr. Henry Coppée, of Pennsylvania, will cease to be members on the 19th of December next; and as the Forty-ninth Congress will commence its session in the same month, it will become the duty of the Speaker to appoint three Regents from the House of Representatives.

The term of Hon. N. P. Hill, of Colorado, as Senatorial Regent, expired on the 3d of March, 1885, and on March 25, 1885, the Vice-President, Mr. Hendricks, appointed Hon. Shelby M. Cullom, of Illinois, as Regent during his term of service as United States Senator. The Vice-President on the same date also re-appointed Hon. J. S. Morrill, of Vermont, for a new term of six years.

Until the next meeting of the Board of Regents, in January, 1886, the vacancy existing in the Executive Committee by the expiration of the term of General Sherman was filled by the appointment of Dr. Henry Coppée *ad interim*, by the remaining members of the committee.

The Board at its last meeting adopted an important resolution, ordering that the fiscal year of the Institution shall terminate on the 30th of June of each year. This changes the practice of the Institution since its organization, and will occasion some difficulty in arranging tables of comparison of receipts and expenditures for annual periods. The reason for the change is that the fiscal year of the Government terminates in June, and as the appropriations made by Congress for the Museum, the exchange system, ethnological researches, &c., are for this period, it was thought advisable for the accounts of the Institution to conform to those of the General Government. The accounts of the Institution have therefore been given in this report only for the six months terminating on the 30th of June, 1885.

Change in the time of printing the Report.—It was also ordered by the Board that "the Secretary shall hereafter prepare and cause to be printed and sent to each member of the Board, on or before the 1st day of December in each year, his annual report."

Difficulty has always been experienced in the early printing of the Annual Report of the Institution. The organic act, August 10, 1846, provides that "the Board" of Regents "shall submit to Congress, at each session thereof, a report of the operations, expenditures, and condition of the Institution.* In accordance with this law the Board has annually submitted to Congress a report of the operations of the Institution, which has been ordered to be printed and a number of extra copies granted for its use and distribution. The Public Printer however has not felt authorized to put any part of the report in type before the adoption by Congress of a special resolution to print the extra copies referred to, and as there has frequently been great delay in the passage of the concurrent resolution, many months have frequently elapsed between the annual meeting of the Board and the printing of the report.

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* Revised Statutes, Title LXXIII, Section 5593.

The best illustration of this delay is furnished by reference to the report of the Institution for the year 1883, which, although submitted to Congress on the 21st of January, 1884, was actually not ordered to be printed till July, 1884, and not delivered to the members and to the Institution until August, 1885.

To remedy this evil and to secure prompt publication, the Regents adopted the resolution referred to above at its last meeting, and by the efforts of the members of the Board in the Senate and House of Representatives secured the passage of the following joint resolution by Congress, No. 18, approved by the President of the United States March 3, 1885:

"*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled*, That the annual reports of the Smithsonian Institution shall be hereafter printed at the Government Printing Office, in the same manner as the annual reports of the heads of Departments are now printed, for submission in print to the two Houses of Congress."

The intent of this act is to instruct the Public Printer to print the Annual Report of the Regents whenever copy shall be furnished, so that the whole report may be presented to Congress in printed form at the commencement of each session.

The statute under which the reports of Departments are printed is as follows:

"The head of each Department, except the Department of Justice, shall furnish to the Congressional Printer copies of the documents usually accompanying his annual report, on or before the first day of November in each year, and a copy of his annual report on or before the third Monday of November in each year.*

"It is further provided that of the documents accompanying the annual reports of the Executive Departments one thousand copies shall be printed and bound for the use of the members of the Senate, and two thousand copies for the use of the members of the House of Representatives, in addition to the usual number for Congress, 1,900 copies."†

While the printing of the report is now secured without a special order at each session of Congress, it will still be necessary to have a concurrent resolution every year for the printing of *extra copies* for the use of the Institution.

FINANCES.

The financial condition of the Institution continues to be satisfactory. The Smithson fund remains the same as at the date of the last report,

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* Revised Statutes, Title IV, section 196.

† Revised Statutes, Title XLV, section 3798.

$703,000, deposited forever in the United States Treasury, from which is received an annual interest of 6 per cent. This interest is paid on the 1st of January and 1st of July, and the money immediately placed in the hands of the Treasurer of the United States, who keeps a special account of it. All payments are made by checks on this officer, signed by the Secretary of the Smithsonian Institution. A monthly statement is rendered by the Treasurer of all checks paid and of the balances. This is compared with the books kept by the accountant of the Institution. A quarterly examination is made by the Executive Committee of the Regents of all the financial transactions of the Institution. The members of the committee sign a certificate, of which the annexed is a copy:

CERTIFICATE.

WASHINGTON, D. C., ———, —, 18—.

The undersigned members of the executive committee of the Board of Regents of the Smithsonian Institution have examined the account for ——— for the ——— ending ——— —, 18—, the receipts amounting to ——— dollars, and the expenditures to ——— dollars, leaving a balance of ——— dollars, as entered in the journal, pages —— to ——, inclusive; and certify the same to be correct. For each disbursement there is a voucher approved by the Secretary of the Smithsonian Institution, and certified by an agent of the Institution that the articles or services charged therein were required and furnished on account of the objects specified, and that the same were necessary and the charges reasonable.

The balance above stated corresponds with the certificate of the ——— Department of ——— 18—.

———,
———,
———,
Executive Committee.

The change of the fiscal year of the Institution, to terminate on the 30th of June instead of the 31st of December, renders it necessary to state in this report the receipts and expenditures for six months only, viz, from January 1 to July 1, 1885:

Cash on hand January 1, 1885		$25,380 84
Expenditures:		
Building, furniture, and fixtures	$552 15	
General expenses, salaries, supplies, books, &c.	11,417 07	
Publications and researches	7,447 21	
Literary and scientific exchanges	3,307 59	
		22,724 02
Balance		2,656 82
Interest on the Smithson fund for the six months ending June 30, 1885		21,090 00
Total on hand July 1, 1885		$23,746 82

The appropriations made by Congress for the system of Exchanges, under the direction of the Smithsonian Institution, have been disbursed by Maj. T. J. Hobbs, of the Treasury Department; those for ethnological researches by Mr. J. D. McChesney, disbursing officer of the United States Geological Survey; those for the preservation of Government collections, furniture, and fixtures, and other objects for the National Museum, by Mr. George W. Evans, disbursing clerk of the Interior Department.

The vouchers for all these expenditures are critically examined by the proper Auditor and the Comptroller of the Treasury, and have been formally passed by those officials.

Every payment for the Institution and its dependencies is made by bonded officers of the Government.

BUILDINGS.

The Smithsonian Building.—As stated in previous reports, two appropriations were made by Congress for fire-proofing the eastern portion of the Smithsonian building and increasing its accommodations for doing the Government work connected with the Museum, the International Exchanges, &c. The whole has now been completed in a thoroughly fire-proof manner, with twice the original number of available office rooms, and with every facility for doing the work mentioned in the best possible manner.

The rest of the Smithsonian building is in an unsightly and dilapidated condition, and will before long require extensive repairs in the way of a new ceiling to the second-story room, and the re-arrangement of cases in the first floor, &c.; an undertaking which, as being strictly in the interest of the National Museum, will warrant the asking Congress for the necessary appropriation.

The exterior of the central portion of the building was in a very bad condition, requiring repainting, reglazing, &c., and this work has been undertaken and practically completed at a moderate expense, greatly improving its appearance.

National Museum Building.—This building is apparently in excellent condition, and has required comparatively little in the way of repairs. An appropriation was made in 1884 for a concrete walk along the southern and eastern sides of the building, and was expended so as to furnish a much-needed improvement in the facilities of access.

Armory Building.—This building, which has been assigned by law for the purposes of the Smithsonian Institution and the United States Fish Commission, is occupied partly for the storage of collections and partly for the active work of the Commission. It now constitutes what is known as the central hatching station of the Commission, where the work of propagation of food fishes is conducted on a very extensive scale. It is also the depot from which shipments of fish are made from Washington to all parts of the country, and for this purpose has a branch track of the Baltimore and Potomac Railroad, by means of which the cars are brought alongside of the building and receive and deliver their loads.

The Brick Workshop.—This building continues to be used for the same purposes as in previous years, a part of it being occupied as a stable, while the greater portion is used for the preparation and mounting of birds, modelling in plaster and papier-maché, in painting the casts of specimens, &c.

Temporary Workshop.—Reference has been made to a large shed or annex, built at the expense of the appropriation for the New Orleans Exposition, and used in the preparation of exhibits for the same, and also for storage of the articles received therefrom, and their special preparation for exhibition. It was also intended to receive the collections as returned until they could be properly assigned to their places or otherwise disposed of. An appropriation was however made by Congress at its last session to meet the cost of restoring the collections sent to New Orleans to their original condition, very serious damage having occurred in consequence of the dampness and other agencies. This has made it necessary to retain the building for the present. As soon as arrangements can be made to receive what is now stored therein, it will be taken down and the ground cleared of what is a serious incumbrance.

Army Medical Museum Building.—For several years the authorities of the Army Medical Museum have been endeavoring to secure an appropriation for the erection of a fire-proof building for the accommodation of the library of the Museum and the offices of the Bureau, so as to obviate any possible danger of loss by fire of important archives and material. An appropriation of $200,000 was finally made by Congress; and the Secretary of War, the Architect of the Capitol, and the Secretary of the Smithsonian Institution were authorized to select a site in the vicinity of the National Museum for the accommodation of the aforesaid building. The committee met and selected the southeast corner of the Smithsonian reservation, extending along Seventh street 170 feet and South B street 260 feet. As the expenditure was contingent upon the adequacy of the appropriation to construct the building in question, the plans were prepared and submitted for estimate to a number of bidders, whose offers were as follows:

Bids for construction of Army Medical Museum Building.

Names of bidders.	Where.	Building proper.	Heating apparatus.	Total.
Bright, Humphrey & Co.	District of Columbia	$165,827 00	$14,160	$179,987 00
M. A. McGowan	do	171,540 17	11,000	182,540 17
Frank Baldwin	do	170,358 00	15,140	185,498 00
C. A. Schneider's Sons	do	172,509 33	15,897	188,406 33
J. T. McDermott (informal.)	do	176,600 00	15,000	191,600 00
Aug. Getz & Co	do	178,600 00	15,400	194,000 00
D. J. McCarty & Co	do	185,295 00	15,300	200,595 00
D. C. Weeks & Son	New York	217,337 00	15,700	233,037 00

It thus appearing that the appropriation was adequate to the demand, a contract was entered into with Messrs. Bright, Humphrey & Co., and the work ordered by the Secretary of War to be prosecuted with the utmost possible diligence.

Necessity of new buildings for the National Museum.—An application was made to Congress a year or two ago for an appropriation with which to commence the construction of a second building for museum purposes, and also to accommodate the offices of the United States Geological Survey, an establishment which in its close affiliation to the work of the Smithsonian Institution and the National Museum would be appropriately quartered in connection therewith. This application however was not granted; but the need is now much greater than before, as there is enough material in the way of valuable specimens of economical interest to fill a second building the size of the present one. This unexhibited surplus is now stored in several buildings, some in Washington and some elsewhere, and consists of important illustrations of the economical geology, metallurgy, and other resources of the United States. In addition to what has been on hand for some time, very large collections were presented to the Government at the New Orleans Exhibition, which embraced a great deal of intrinsic value as well as of popular and scientific interest. It is earnestly to be hoped that this requirement will be met by Congress by the speedy appropriation of an amount suitable for the purpose.

For the safety of the general collections of the National Museum a separate building is also very much needed for the accommodation of the alcoholic specimens, such as are now provided by most first-class museums. Although the present building is practically fire-proof, yet should a fire be started in the vicinity of these specimens it is probable that much damage would be done by the ignition of the many thousands of gallons of alcohol, and the destruction of the specimens and of the jars in which they are contained.

EXPLORATIONS.

As the present report, in view of the change of the fiscal year of the Smithsonian Institution, covers only the period from January 1 to June 30, 1885, the account of explorations will necessarily be much shorter than usual, especially as such work frequently does not begin until midsummer. The completion of the history of 1885 must therefore be deferred until the next report.

Greenland, Labrador, and the British Provinces.—Reference has been made in a previous report to the return of the Greely expedition and to the general results accomplished. Specimens illustrating the botany of the region in the vicinity of Lady Franklin Bay have been sent to the National Museum by Lieutenant Greely.

Mr. Lucien M. Turner has been engaged in preparing his report upon the natural history and meteorology of the region about Fort Chimo, Ungava Bay, Northern Labrador, where he spent several years, as stated in the last report. As he completes his investigations of the various collections, they are turned over to the National Museum, and represent very important additions to its treasures. The report will be made to the U. S. signal officer.

Important material, especially in geology and palæontology, has been received from the Geological Survey of Canada.

Alaska.—There has been an unusual amount of activity in the investigation of the geography and natural history of Alaska, especially the northern portion. Lieut. George M. Stoney, of the United States Navy, with a force of naval officers and men, has been engaged in continuing the explorations made by him in 1884, and already reported upon. The revenue cutter Corwin also again visited the Arctic Ocean, and parties were sent up the Kowak and other rivers emptying into Kotzebue Sound. Mr. Charles H. Townsend, an accomplished collector, accompanied the vessel and made many interesting gatherings in natural history. Mr. Henry D. Woolfe, agent of the Pacific Steam Whaling Company, stationed at Cape Lisburne, in the Arctic Ocean, has also collected numerous specimens, including shells and marine invertebrates. A few of these have been sent in, but the greater part of the collection has yet to come.

Mr. John J. McLean, signal observer at Sitka, has continued his transmissions of rare and interesting archæological material, while Mr. W. J. Fisher, at Kodiak, has forwarded additional series of ethnological objects, birds, &c. Mr. Johnson, Signal Service observer at Nushagak, has transmitted some desirable specimens of birds.

Washington Territory and the west coast of the United States.—Mr. James G. Swan, of Port Townsend, has furnished a number of interesting ethnological specimens, obtained from the Indians of Puget Sound, and Ensign A. P. Niblack, U. S. N., attached to the United States Coast Survey steamer Carlile P. Patterson, while proceeding in that vessel from San Francisco around Cape Horn and thence to Alaska, gathered many notes upon the natural history and ethnology of the country, and transmitted them to the Smithsonian Institution, with quite a number of specimens.

East coast of the United States and Gulf of Mexico.—During the first half of the year 1885 the steamer Albatross, of the United States Fish Commission, continued its important exploration into the fisheries and the natural history and physical condition of the waters adjacent to the coast of the United States. The winter and early spring were spent in the Gulf of Mexico in search of new fishing grounds for valuable fish, and in June was commenced a similar work on the banks of Newfoundland and the other fishing banks still nearer to the coast of New England. The result of these explorations, when published, will be found to be of much practical benefit and will add greatly to our information.

New Mexico and Arizona.—Mr. E. W. Nelson has continued his work in connection with the archæology and natural history of Arizona, and has sent in a large number of boxes of valuable collections.

Dr. R. W. Shufeldt, at Fort Wingate, N. Mex., has also supplied much interesting material.

Dr. F. W. Taylor has sent some rare minerals and fossils from the vicinity of Lake Valley.

Mexico and Lower California.—Mr. L. H. Aymé, to whom reference has been made in previous reports, has continued his explorations and investigations into the natural history and ethnology of Western Mexico, and has contributed much material to the National Museum.

Professor Dugés, of Guanajato, has also sent in a number of interesting specimens for identification.

Dr. Edward Palmer was sent to make explorations into the ethnology of the regions in the vicinity of Chihuahua, and was enabled by the courtesy of Mr. A. R. Shepherd to acquire many interesting articles in the neighborhood of Batopilas.

The investigations of Mr. Charles H. Townsend in regard to the occurrence of the great seal, known as the sea-elephant, were crowned with success, some eight or ten specimens having been obtained and forwarded to the National Museum. It is confidently asserted that these represent the last of the race and that we may fairly consider the species as extinct on our coast.

Central and South America.—Prof. Miles Rock, who was appointed by the Government of Guatemala as astronomer in the boundary survey between Guatemala and Mexico, kindly offered his services to make photographs and collections of any interesting objects he might find, and has already fulfilled his promise by the transmission of a large amount of material, including photographs, specimens of birds, and objects of archæology.

Mr. J. C. Zeledon, of Costa Rica, has also continued the transmissions begun by him many years ago, and has supplied the National Museum with an almost complete collection of the vertebrate animals of that country.

Dr. W. H. Jones, of the United States Navy, was very successful in archæological research on the coast of Peru and Chili, and the specimens received from him are among the most highly prized of the articles in the National Museum.

Mr. George Kiefer, of Lima, has also made contributions of the same character.

Europe.—Mr. Thomas Wilson, late consul at Nice, France, has been busy during the greater part of his official term as consul, first at Nantes and then at Nice, in France, in explorations into the remains of prehistoric man, and has presented a very large collection, the unpacking of which only awaits his return to this country. It is believed that this collection, filling a large number of boxes, will prove to be one of the richest and most complete of its kind ever sent to the United States.

The results of minor researches of more or less productiveness, will be detailed in the accompanying report of the National Museum.

PUBLICATIONS.

In view of the fact that the Annual Report of the Institution is yearly presented to a number of readers for the first time, it seems proper to repeat frequently the general statement that the publications prepared by it embrace three different classes. These are:

First, a quarto series of volumes of irregular issue entitled "Smithsonian Contributions to Knowledge," which consist of original memoirs furnishing additions to scientific information, corresponding somewhat with the Transactions of learned societies, though generally forming more elaborate treatises than such publications. As a rule these contributions to positive knowledge are based on experiments, observations, or material, carefully undertaken or gathered by the Institution, or they are the results of investigations originated or encouraged and assisted by its means.

The second class of publications is an octavo series of volumes entitled "Smithsonian Miscellaneous Collections," which also include the presentation of a large amount of new truths developed by original research, but which contain in addition useful summaries, essays on improvements in classification—in zoology, botany, and other departments of science, and new and extended tables of physical, chemical, and other natural constants; all of which possess great value in aiding the labors of scientific specialists in many directions, and at the same time are calculated to encourage inquiring minds to prosecute particular lines of investigation, as well as to afford facilities to such students.

The third class of publications is an octavo series of "Smithsonian Reports," presented annually to Congress, which include, in addition to the usual record and statement of operations for the year, a considerable amount of carefully prepared matter on various scientific topics intended for the general reader.

Distribution.—These publications are liberally distributed for the diffusion of knowledge, but from the absolute impossibility of producing editions large enough to supply all intelligent inquirers who might be interested in their perusal, the distribution is now confined: 1st, to those learned societies of the first class which give to the Institution in return complete sets of their own publications; 2d, to colleges of the first class furnishing catalogues of their libraries and students, and publications relative to their organization and history; 3d, to public libraries in this country having 25,000 volumes; 4th, they are presented in some cases to still smaller libraries, especially if no other copies of the Smithsonian publications are given in the same place, and a large district would be otherwise unsupplied. To institutions devoted exclusively to the promotion of particular branches of knowledge, such of its publications are given as relate to their special objects.

Smithsonian Contributions to Knowledge.—A work on "Prehistoric Fishing in Europe and North America," by Dr. Charles Rau, mentioned in my last report (that for 1884) as being in type and nearly ready for the press, was printed and published early in the year, and has since been distributed in accordance with the general practice adopted. This work forms a volume of 342 pages (including the index), with 18 pages of introductory matter, in all 360 pages, and is illustrated with 406 figures. Part I, occupying nearly one-third of the memoir, is devoted to the archæological relics of Europe, giving a concise though comprehensive survey of whatever is supposed to relate to fishing, under the three epochs of the palæolithic age, the neolithic age, and the bronze age. Part II is occupied with the archæological fishing relics of North America, under the general headings of "Fishing Implements and Utensils," "Boats and Appurtenances," "Prehistoric Structures connected with Fishing," "Aboriginal Representations of Fishes, Aquatic Mammals, &c.," and, lastly, "Artificial Shell-Deposits." This descriptive summary is supplemented by an interesting collection of extracts compiled from various writings of the sixteenth, seventeenth, eighteenth, and nineteenth centuries, in which reference is made to aboriginal fishing in North America.

During the past year two volumes of the Contributions to Knowledge have been made up from outstanding memoirs.

Volume XXIV comprises: Article I, "Results of Meteorological Observations made at Providence, R. I., extending over a period of forty-five years, from December, 1831, to December, 1876." By Prof. Alexis Caswell, of Brown University, Providence, R. I. Published in 1882 (an account of which was given in the Annual Report for that year). Article II, "Tables and Results of the Precipitation in Rain and Snow in the United States, and at some stations in adjacent parts of North America and in Central and South America. Collected by the Smithsonian Institution, and discussed under the direction of Joseph Henry and Spencer F. Baird, Secretaries." By Charles A. Schott. Second edition published in 1881 (an account of which was given in the Annual Report for that year). The whole forms a volume of 311 pages, illustrated with 8 diagrams in the text, and accompanied by 5 plates and 5 large folding maps of the United States, showing the curves of equal precipitation for each of the four seasons and also for the year.

Volume XXV comprises: Article I, "Prehistoric Fishing in Europe and North America." By Dr. Charles Rau (just previously described).

Article II, "Archæological Researches in Nicaragua." By J. F. Bransford, M. D. Published in 1881 (an account of which was given in the Annual Report for that year). Article III, "On the Contents of a Bone Cave in the Island of Anguilla, West Indies." By Edward D. Cope. Published in 1883 (an account of which was given in the Annual Report for that year). The whole forms a volume of 509 pages, illustrated with 545 cuts or figures and accompanied by 7 engraved plates.

Smithsonian Miscellaneous Collections.—The ten following numbers comprise pamphlet editions of papers published by the Institution, which being extracted from the Annual Report for 1883, should properly have appeared during the year 1884; but which, through delay at the Government Printing Office, were not actually issued till the present year.

577. "An Account of the Progress in Meteorology in the year 1883." By Prof. Cleveland Abbe. This, with 4 pages of index, comprises 92 pages 8vo.

578. "An Account of the Progress in Physics in the year 1883." By Prof. George F. Barker. 8vo. 52 pp.

582. "An Account of the Progress in Zoology in the year 1883." By Theodore Gill. 8vo. 53 pp.

583. "An Account of the Progress in Anthropology in the year 1883." By Prof. Otis T. Mason. 8vo. 43 pp.

585. "Addresses at the Unveiling of the Joseph Henry Statue at Washington, D. C., April 19, 1883." By Chief Justice Waite, Chancellor of the Smithsonian Institution, and Noah Porter, LL. D., president of Yale College. Preceded by a sketch of the proceedings on that occasion; and illustrated with a page wood-cut of the bronze statue as it appears in the Smithsonian grounds. 8vo. 27 pp.

586. "Report of Prof. Spencer F. Baird, Secretary of the Smithsonian Institution, to the Board of Regents, for the year 1883." 8vo. 86 pp.

587. "Report of the Assistant Director of the United States National Museum, together with the Reports of the Curators, for the year 1883." 8vo. 200 pp.

588. "Miscellaneous Papers relating to Anthropology." By A. W. Howitt, James Wickersham, W. H. Adams, Augustus A. Foerste, J. P. MacLean, William J. Taylor, S. T. Walker, L. A. Kengla, John A. Ruth, Henry Booth, Henry E. Chase, and Charles C. Nutting. 8vo. 122 pp.

596. "Australian Group Relations." By A. W. Howitt. 8vo. 28 pp.

605. "On the Comparative Phonology of four Siouan languages." By Rev. J. Owen Dorsey. 8vo. 11 pp.

Among the issues properly belonging to the year 1885, the first and most important is No. 538 of the Smithsonian series—"Tables, Meteorological and Physical." By Dr. Arnold Guyot, of Princeton College. Fourth edition, revised and enlarged. Edited by William Libbey, jr.

A quarter of a century has passed since the publication of the third edition of this valuable and elaborate work. The first edition of the Tables was published by the Institution in 1852, comprising 212 pages. Five years later (in 1857) a second edition was published, with careful revision by the author, and the various series of tables were so enlarged as to extend the work to over 600 pages. The third edition was published in 1859, with still further amendments.

To this volume Dr. Guyot, with untiring industry, has been making constant additions; and the present issue, projected by him in 1879 (from various delays occasioned by pressing professional occupations, as well as by illness and death in his family), was about four years in passing through the press. Just before completing the last few tables, the estimable and distinguished author departed this life, February 8, 1884, in the seventy-seventh year of his age. The completion of the work was intrusted to his able assistant, Prof. William Libbey, jr., who has judiciously executed his duties as the final editor of the work. The tables are arranged in seven series. The first series (comprising 15 tables), thermometrical comparisons and conversions; the second series (of 33 tables), hygrometrical computations; the third series (of 27 tables), barometrical; the fourth series (of 27 tables), hypsometrical; the fifth series, geographical tables, including 40 of measures of length (for heights, &c.), 10 of itinerary measures, and 10 of square measures of geographical surface; the sixth series (of 99 tables) for corrections of variations of temperature, &c., at different parts of the earth; and the seventh series comprising 9 miscellaneous tables. The whole forms an octavo volume (including 25 introductory pages) of 763 pages.

No. 545. "Proceedings of the Biological Society of Washington: Vol. II." From July 1, 1882, to July 1, 1884. 8vo. 195 pp.

592. "Bulletin of the Philosophical Society of Washington: Vol. VII, containing the Minutes of the Society and of the Mathematical Section for the year 1884." From January 5, 1884, to December 20, 1884. 8vo. lix+135 pp., or 194 pp.

594. "Mental overwork and premature disease among public and professional men." By Charles K. Mills, M. D. Being lecture IX of the "Toner Lectures"; delivered in Washington, D. C., March 19, 1884. 8 vo. 34 pp.

595. "The Refraction of Sound." By William B. Taylor. A reprint from the Smithsonian Report for 1875. 8vo. 12 pp., with 6 figures.

608. "Report of Prof. Spencer F. Baird, Secretary of the Smithsonian Institution, to the Board of Regents, for the year 1884." 8vo. 98 pp.

609. "An Account of the Progress in Astronomy in the year 1884." By Prof. Edward S. Holden. 8vo. 55 pp.

610. "A Review of the Progress of North American Invertebrate Paleontology for the year 1884." A bibliography of publications on the subject for the year. By John Belknap Marcou. 8vo. 20 pp.

611. "An Account of the Progress in Geography in the year 1884." By Commander F. M. Green, U. S. N. 8vo. 19 pp.

612. "An Account of the Progress in Meteorology in the year 1884." By Prof. Cleveland Abbe. 8vo. 176 pp.

613. "An Account of the Progress in Physics in the year 1884." By Prof. George F. Barker. 8vo. 57 pp.

614. "An Account of the Progress in Chemistry in the year 1884." By Prof. H. Carrington Bolton. 8vo. 52 pp.

615. "An Account of the Progress in Mineralogy in the year 1884." By Prof. Edward S. Dana. 8vo. 19 pp.

616. "An Account of the Progress in Vulcanology and Seismology, in the years 1883 and 1884." By Prof. Charles G. Rockwood, jr. 8vo. 21 pp.

617. "An Account of the Progress in Zoology in the year 1884." By Theodore Gill. 8vo. 93 pp.

618. "An Account of the Progress in Anthropology in the year 1884." By Prof. Otis T. Mason. 8vo. 41 pp.

619. "Antiquities at Pantaleon, Guatemala." By Lieut. Charles E. Vreeland and Dr. J. F. Bransford, U. S. N. 8vo. 12 pp. Illustrated with 12 figures.

620. "Miscellaneous Papers relating to Anthropology." By M. L. Leach, Charles M. Smith, and E. T. Wiltheiss. 8vo. 38 pp. Illustrated with 16 figures.

621. "The Guesde Collection of Antiquities in Pointe à Pître, Guadaloupe, West Indies." By Prof. Otis T. Mason. 8vo. 107 pp. Illustrated with 221 figures.

The Scientific Writings of Joseph Henry.—Good progress has been made in the collation and printing of the collected scientific writings of Professor Henry; 600 octavo pages, or more than half the entire work, having now (July 1) been set up in type, corrected, and stereotyped. It is estimated that the entire work will comprise 1050 pages; and it is hoped that the whole will be stereotyped and printed off by the close of the present year.

Bulletins of the National Museum.—These form a series (as heretofore explained) designed to supply a prompt publication of original descriptions of specimens received by the National Museum, and of other allied matter. While these are primarily printed under the direction of the honorable Secretary of the Interior, a supplementary edition is published from the stereotype plates by the Institution for the benefit of its correspondents, and they are included in its "Miscellaneous Collections."

Bulletin No. 27 comprises "Descriptive Catalogues of the Collections sent from the United States to the International Fisheries Exhibition, London, 1883; constituting a Report upon the American Section," prepared under the direction of G. Brown Goode, United States commissioner, and a staff of associates. It contains a preliminary catalogue and synopsis of the collections exhibited by the United States Fish Commission and by special exhibitors; a concordance of the official classification for the use of the juries; collection of economic crustaceans, worms, echinoderms, and sponges, by Richard Rathbun; a catalogue of the aquatic and fish-eating birds, by Robert Ridgway; a catalogue of the economic mollusca and the apparatus and appliances used in their capture and preparation for the market, by Lieut. Francis Winslow, U. S. N.; the whale-fishery and its appliances, by James Temple Brown; a catalogue of the collection of fishes, by Tarleton H. Bean; a descriptive catalogue of the collection illustrating the scientific investigation of the sea and fresh waters, by Richard Rathbun; a catalogue of the aquatic mammals, by Frederick W. True; a catalogue of the collection illustrating the fishing vessels and boats and their equipment, the economic condition of fishermen, anglers' outfits, &c., by Capt. Joseph W. Collins; a catalogue of the apparatus for the capture of fish, by R. Edward Earll; a catalogue of fishery products and of the apparatus used in their preparation, by A. Howard Clark; and a catalogue of the fish-cultural exhibit, by R. Edward Earll; the whole forming (with introductory matter and general index) an octavo volume of 1333 pages.

Report on the Reptiles and Batrachians of North America.—The Smithsonian Institution may claim the credit of having done more than any other organization or any individual in furnishing to the students and naturalists of the country convenient and effective text-books for the determination of the natural history of the United States and North America. In proof of this it is sufficient to point to what has been done in the way of systematic treatises on mammals, birds, fishes, certain groups of mollusks, &c.

Although a number of monographs of reptiles have been published more or less directly under its auspices, such as that of the serpents and other groups, there is still lacking a compact manual of both the reptilia and batrachia; and arrangements were accordingly made with Professor Cope, of Philadelphia, to supply this want. This gentleman is well known for his professional acquaintance with these groups as studied by him in the collections in the Museum of the Academy of Natural Sciences of Philadelphia, the National Museum of Washington, and elsewhere. An agreement was therefore made with him for the preparation of a much-needed manual on the reptiles and batrachians of North America; a year's time being allowed, at a suitable compensation, for the final and critical examination of the collections of the National Museum and the preparation of the report. In this way the entire field of the vertebrates of North America will have been completely covered.

Proceedings of the National Museum.—This series, somewhat allied to the series of "Bulletins," comprises papers relative to the collections—

generally of a less elaborate character, and aiming at a still greater promptness of issue by having printed single "signatures" of the periodical so soon as the matter is furnished.

Volume VII of the "Proceedings of the National Museum" was completed during the early part of the year, and contains descriptive papers by Tarleton H. Bean, Charles E. Bendire, F. W. Clarke, W. H. Dall, Frederick P. Dewey, H. G. Dresel, C. H. Fernald, Charles H. Gilbert, Theodore Gill, G. Brown Goode, Asa Gray, Romyn Hitchcock, David S. Jordan, Seth E. Meek, George P. Merrill, John Murdoch, E. W. Nelson, Temple Prime, Richard Rathbun, Robert Ridgway, J. T. Rothrock, John A. Ryder, R. W. Shufeldt, Elisha Slade, Sidney I. Smith, Rosa Smith, Leonhard Stejneger, Joseph Swain, Cyrus Thomas, and Frederick W. True; forming an octavo volume of 670 pages, illustrated with 8 figures and 2 plates.

The following circulars have been published as appendices to the Proceedings of the National Museum:

589. Circular No. 22. "Brief directions for removing and preserving the skins of mammals." By William T. Hornaday. 8vo. 7 pp.

590. Circular No. 23. "Instructions for taking paper molds of inscriptions in stone, wood, bronze, &c.," prepared by A. P. Niblack. 8vo. 5 pp.

597. Circular No. 24. "Plan of a Collection to illustrate the textile industries of the United States, to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–'85, at New Orleans." By Romyn Hitchcock. 8vo. 16 pp.

598. Circular No. 25. "Preliminary plan for a collection of the building and ornamental stones and rocks of the United States, to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–'85, at New Orleans." By George P. Merrill. 8vo. 2 pp.

599. Circular No. 26. "Plan for a collection of gems and precious stones to be exhibited at the Cincinnati Industrial Exposition, and the World's Industrial and Cotton Centennial Exposition of 1884–'85, at New Orleans. By F. W. Clarke. 8vo. 2 pp.

600. Circular No. 27. "Directions for collecting, preserving, and transporting tortricids and other small moths." By C. H. Fernald. 8vo. 3 pp.

601. Circular No. 28. "Directions for mound explorations." By Cyrus Thomas. 8vo. 3 pp.

602. Circular No. 29. "Provisional plan for a collection of mammals to be exhibited at the World's Industrial and Cotton Centennial Exposition of 1884–'85, at New Orleans." By Frederick W. True. 8vo. 27 pp.

603. Circular No. 30. "A list of birds, the eggs of which are wanted to complete the series in the National Museum, with instructions for collecting eggs." By Charles E. Bendire. 8vo. 4 pp.

604. Circular No. 31. "Plan to illustrate the mineral resources of the United States, and their utilization, at the World's Industrial and

Cotton Centennial Exposition of 1884–'85, at New Orleans." By Frederick P. Dewey. 8vo. 8 pp.

622. Circular No. 32. "Classification of the Materia Medica collection of the United States National Museum, and catalogue of specimens." By James M. Flint. "Revised and extended" by Henry G. Beyer. 8vo. 39 pp.

626. Circular No. 33. "Notes on the preparation of rough skeletons." By Frederick A. Lucas. 8vo. 8 pp., with 12 figures.

The Smithsonian Annual Report.—The third class of publications consists of Annual Reports of the Board of Regents of the Smithsonian Institution, presented to Congress, and printed by authority of that body. The Report of 1883 was not issued till 1885. It contains the report of the Secretary of the Institution for the year, supplemented by the correspondence relative to the transfer of astronomical announcements by telegraph to Harvard College Observatory; the report on the operations of the Smithsonian system of international and domestic exchanges; and the report of the Assistant Director of the National Museum on the condition of that department, together with a general Appendix, embracing a record of scientific progress for the year,—in astronomy, by Edward S. Holden; geology, by T. Sterry Hunt; geography, by F. M. Green; meteorology, by Cleveland Abbe; physics, by George F. Barker; chemistry, by H. Carrington Bolton; mineralogy, by Edward S. Dana; botany, by W. G. Farlow; zoology, by Theodore Gill; and anthropology, by Otis T. Mason; together with miscellaneous papers relative to anthropology, by A. W. Howitt, James Wickersham, W. H. Adams, Augustus A. Foerste, J. P. MacLean, William J. Taylor, S. T. Walker, L. A. Kengla, John A. Ruth, Henry Booth, Henry E. Chase, Charles C. Nutting, and J. Owen Dorsey. The Report forms an octavo volume of 997 pages (including introductory matter and index), illustrated with 33 figures and sketch-maps and 1 plate.

The "Annual Report of the Board of Regents of the Smithsonian Institution, for the year 1884," forming an 8vo. volume of 943 pages (including introductory matter and index), has been most unfortunately delayed, and is not yet published.

Publications of the Bureau of Ethnology.—To the three preceding classes of established publications (one of quarto size, and two of ordinary octavo size), a fourth class, of imperial octavo size, embracing the publications of the Bureau of Ethnology, under the direction of the Smithsonian Institution, may now properly be added. Of this series two volumes have already appeared.

The "First Annual Report of the Bureau of Ethnology, to the Smithsonian Institution," by J. W. Powell, Director, though published two years ago, was not noticed in the last report of the Secretary. This work contains papers by J. W. Powell (in addition to his report proper), by H. C. Yarrow, E. S. Holden, C. C. Royce, Garrick Mallery, J. C. Pilling, J. O. Dorsey, A. S. Gatschet, and S. R. Riggs. It forms an imperial octavo volume of 638 pages (including introductory matter and index), and is illustrated with 292 figures in the text, 2 maps, and 53 plates, of which four are colored.

The "Second Annual Report of the Bureau of Ethnology, to the Smithsonian Institution," by J. W. Powell, Director, contains papers by J. W. Powell, Frank H. Cushing, Erminnie A. Smith, Henry W. Henshaw, Washington Matthews, William H. Holmes, and James Stevenson. It forms an imperial octavo volume of 514 pages (including introductory matter and index), and is illustrated with 60 figures in the text, 2 maps, and 173 plates, of which 12 are colored. The plates contain about 750 separate figures.

INTERNATIONAL EXCHANGES.

One of the most important factors in the "diffusion of knowledge among men" is found in the system of international exchange carried on by the Smithsonian Institution. Originally only intended for the distribution of its own publications, the Institution by degrees extended its usefulness and privileges to learned societies and individuals of both hemispheres, and at present this exchange service forms the medium of scientific intercourse between about 700 home institutions and 4,000 establishments distributed over all parts of the inhabited globe.

The gradual development of this service has resulted in a large increase both in the work to be performed and in the number of employés. The management of this branch has, since the year 1880, been in charge of Mr. George H. Boehmer, and to his detailed report, hereto appended, I refer for more minute information.

Statistics.—The increase in the number of parcels received will best be illustrated by the following comparison of the first six months of 1885 with the full years of 1882, 1883, and 1884:

Receipts.	1882.		1883.		1884.		Six months—1885.	
	Packages.	Pounds.	Packages.	Pounds.	Packages.	Pounds.	Packages.	Pounds.
Foreign exchanges ..	19,292	83,720	18,063	78,647	18,866	78,732	10,688	60,475
Domestic exchanges ..	7,187	30,904	8,262	49,608	7,967	42,255	3,679	14,375
Government exchanges	31,568	28,750	37,569	27,395	38,337	32,827	29,233	22,182
Total...	58,047	143,374	63,894	155,650	65,170	153,814	43,600	97,032

The transmissions of exchanges have been in direct ratio to the increase in the receipts, being for the first six months of 1885:

(1) Foreign exchanges: 345 boxes, representing a bulk of 2,415 cubic feet, with a weight of 82,800 pounds, against 276 boxes during the same period of 1884.

(2) Domestic exchanges: 5,138 packages, this being a little above the half of the total number sent out during the year 1884.

(3) Government exchanges: 38 boxes, representing a bulk of 266 cubic feet, with a weight of 10,500 pounds.

Congressional Aid.—The Smithsonian Institution continues to receive the usual Congressional appropriation of $10,000 to carry out the operations of the exchange service. The Library of Congress is the principal beneficiary of the exchanges, large numbers of books and parcels being annually received for that institution.

Transportation Companies.—A very important contribution toward the expenses of the exchange service consists in the granting of free freight on the exchange parcels or boxes by the following transportation companies and firms, for which liberality acknowledgments are hereby gratefully rendered:

Allan Steamship Company (A. Schumacher & Co., agents), Baltimore.
American Colonization Society, Washington, D. C.
Anchor Steamship Line (Henderson & Brother, agents), New York.
Atlas Steamship Company (Pim, Forwood & Co., agents), New York.
Bailey, H. B., & Co., New York.
Bixby, Thomas E., & Co., Boston, Mass.
Borland, B. R., New York.
Boulton, Bliss & Dallett, New York.
Cameron, R. W., & Co., New York.
Compagnie Générale Transatlantique (L. de Bébian, agent), New York.
Cunard Royal Mail Steamship Line (Vernon H. Brown & Co., agents), New York.
Dennison, Thomas, New York.
Hamburg American Packet Company (Kunhardt & Co., agents), New York.
Inman Steamship Company, New York.
Merchants' Line of Steamers, New York.
Monarch Line (Patton, Vickers & Co., agents), New York.
Muñoz y Espriella, New York.
Murray, Ferris & Co., New York.
Netherlands-American Steam Navigation Company (H. Cazaux, agent), New York.
New York and Brazil Steamship Company, New York.
New York and Mexico Steamship Company, New York.
North German Lloyd (agents, Oelrichs & Co., New York; A. Schumacher & Co., Baltimore).

Pacific Mail Steamship Company, New York.
Panama Railroad Company, New York.
Red Star Line (Peter Wright & Sons, agents), Philadelphia and New York.
White Cross Line of Antwerp (Funch, Edye & Co., agents), New York.
Wilson & Asmus, New York.

The concessions of reduced freight on the part of the Pennsylvania Railroad Company and the Baltimore and Ohio Railroad Company, as well as by the line of freight steamers between Washington and New York, have been continued.

The thanks of the Institution are also due to the foreign ministers and consuls of the various Governments for their assistance in taking charge of the transmission of boxes to the countries which they respectively represent.

Government Exchanges.—By enactment of Congress of March 2, 1867, the Institution was appointed the agent of the United States in an exchange of official public documents with foreign Governments. As provided for by Congress, 50 copies of all official publications, whether emanating from Congress or any Department or Bureau of the Government, whether printed at the Congressional Printing Office or elsewhere, must be delivered to the Library of Congress for distribution by the Smithsonian Institution and to such foreign Governments as are willing to furnish to the Library of Congress a corresponding return from their publications. The conditions of this exchange having been accepted by 38 Governments—of which 19 are European—one box (the 23d of the series since the establishment of this exchange) of United States publications was sent to each of these Governments in April, 1885.

The returns having for some years fallen considerably short of expectations, Mr. George H. Boehmer, in charge of the exchange office, was detailed, at the request of the Librarian of Congress, and with the sanction of the chairman of the Joint Committee on the Library, to visit Europe for the purpose of arranging for better and fuller returns on the part of those Governments exchanging with the United States. For detailed information of the progress of his mission, success obtained, and suggestions relative to the service, I would refer to the report on the subject contained in the section "Government exchange division" of his report on the operations of the exchange office, hereto appended.

Mr. Boehmer left on his mission on the 24th of July, 1884, and returned on the 20th of February, 1885, during which time he visited consecutively nearly all the European states, obtaining satisfactory results and securing large and valuable additions for the library, consisting mostly of parliamentary papers and compilations of the laws of the various Governments.

One of the principal obstacles preventing the establishment of permanently satisfactory measures on the part of the European Governments, and which can perhaps be obviated by a personal representation in Europe, is caused by the entirely different understanding of the exchange question in those countries, resulting from the exchange conventions of Paris in 1875 and 1880, and Brussels in 1883, and by the absence of sufficient legislation by them for securing copies of official publications for exchange purposes.

The governmental bureaus of most of the European states issue their publications through the medium of publishing houses, receiving from these about 50 per cent. from the sales of the books. Copies for gratuitous distribution, therefore, are not issued, but the books represent a trade value which is accepted by the exchange Commissions (established on the basis adopted at the Paris Convention of 1875), who are allowed only to exchange value for value.

The publications of the United States, being issued at the public expense, and not considered as purchased (although they are quoted at very high prices in the book trade, and especially abroad), it becomes under these circumstances difficult to obtain in Europe satisfactory returns. It is therefore suggested by Mr. Boehmer that in future transactions the market value, as given by the foreign book trade, be accepted, which would enable our Government to obtain more satisfactory returns.

Preliminary arrangements have been effected with the Imperial Government of Austria for a complete exchange of all the official and scientific publications of the two Governments.

The Government of Uruguay has also forwarded to the Smithsonian Institution, through the United States Department of State, propositions relative to a full and permanent exchange of official public documents.

LIBRARY.

The following is a statement of the books, maps, and charts received by the Smithsonian Institution from January 1 to June 30, 1885:

Volumes:		
Octavo or smaller	688	
Quarto or larger	222	
		910
Parts of volumes:		
Octavo or smaller	1,971	
Quarto or larger	2,238	
		4,209
Pamphlets:		
Octavo or smaller	4,612	
Quarto or larger	256	
		4,868
Maps		354
Total		10,341

CO-OPERATIVE RELATIONS OF THE SMITHSONIAN INSTITUTION.

Duplicate Collection of Building Stones for the American Museum of Natural History, New York.—Among the various important subjects of inquiry on the part of the census organization of 1880, was one into the statistics of the quarries in the United States used to furnish building stones for building and ornamental purposes, and an arrangement was made by General Walker with Dr. G. W. Hawes, curator of mineralogy and lithology of the National Museum, to collect the necessary material, and to prepare a complete report on the subject, this to be done at the expense of the United States. General Walker also authorized an arrangement by which, on payment of all the costs, Mr. Morris K. Jesup was to have a duplicate collection, with a view to its presentation to the American Museum of Natural History. Estimating the cost of acquisition of the specimens and their preparation, including a microscopical section of each specimen, at $3.50 each, and the number of specimens to be treated at one thousand, the sum of $3,500 was placed at the command of Dr. Hawes for the purpose in question. The work upon this series was prosecuted with much vigor until interrupted by the death of Dr. Hawes. During the present year however, the work was renewed, and the necessary means being furnished by Mr. Jesup, extra workmen were employed upon his collection, which will probably be ready for delivery in the course of the year 1885. By thus duplicating the collection without expense to the Smithsonian Institution or the National Museum, the opportunity of study and comparison will be, of course, greatly extended.

Bureau of Education.—In accordance with the general policy of the Institution to do nothing with its funds which can equally well be done by other means, and to co-operate with other bureaus and departments of the Government, the Institution turned over to the Commissioner of Education 3,326 catalogues, announcements and reports of colleges and educational institutions, together with 401 letters, and 1,978 card-slips, containing an alphabetical list of the entire series.

The Diplomatic Review.—In March, 1883, the conductors of "The Diplomatic Review" of England sent to the Smithsonian Institution an offer of the Review to any library that would undertake to bind it.

By some strange mishap the letter containing this very liberal offer went astray, and no attention was paid to it. In October, 1884, the offer was renewed by Mr. C. D. Collet, the letter being accompanied by a list of libraries to which the Review had been sent direct. This letter was the initiatory step of a correspondence, which will eventually result in the distribution of several hundred sets of the Diplomatic Review, as full as the conductors thereof can furnish.

The Diplomatic Review commenced in 1855, and carried on to the end of 1865, under the title of the *Free Press*, is a continuation of the first and second series of the *Portfolio*, in which, nearly half a century ago, the late Mr. William Pollard Urquhart began his series of articles on the political history of Europe. In the pages of the *Diplomatic Review* will be found Russian secret dispatches, together with other rare and interesting documents on the history of Europe from the time of the Protocol of April 4, 1826, for the "Pacification of Greece," to the end of the Servian war, in 1876. Besides these scarce documents, the *Diplomatic Review* contains many original works of Mr. Urquhart, and a mass of the transactions of the Foreign Affairs Committees of Workingmen formed by him at the time of the Crimean war.

Among these papers the following may be mentioned: Will of Peter the Great, brought to Paris by the Chevalier d'Eon in 1757; Danger to the Political Balance of Europe, by Gustavus III, King of Sweden, 1791; Protocol of a Conference at Constantinople between the British Ambassador and the Divan on the Connexion of Russia with the Greek Revolt, 1822; Memoir of Count Bernstorff to the King of Prussia on the means of annexing the Minor German States, 1831, &c.

On the 18th of April, 1885, in pursuance of the above-mentioned notice, a printed circular was sent to over 400 of the principal libraries, educational institutions, and kindred establishments, to the following effect:

> This Institution is informed by the Conductors of *The Diplomatic Review* of England, that "a set of the twenty-five volumes of the Review, stitched and wrapped in seven books," will be presented to your library "on the condition of your binding them, so that they may be safely preserved for reference."
>
> *The Diplomatic Review* extends from the 13th of October, 1855, to the 3d of January, 1877, and contains rare and interesting documents relative to the history of Europe from 1826 to 1876. It is proper to notify you that the successive volumes were printed in different sizes:
>
> Book I is in folio, and comprises two volumes.
>
> Books II, III, and IV, are quarto, comprising sixteen volumes.
>
> Books V, VI, and VII, are octavo, comprising seven volumes, and supplement.
>
> Please notify this Institution whether this offer is accepted by your library; or, if you have already received a set, whether you desire another on the same terms.

Replies to the above were received as follows: 236 accepted the entire set; 8 desired portions to complete partial sets previously received, and 43 declined, generally on the ground that the character of the information contained in the Review did not come within the scope of the library. Quite a number of libraries have not noticed the circular or the offer contained.

A list was prepared, and sent to Mr. C. D. Collet, of those libraries which accepted, and inasmuch as the sets were all declared to be more or less incomplete, preference was given to the more important libraries, in order that the volumes might reach the greatest number of readers.

Newfoundland Postage on Exchanges.—An arrangement has been made with the postmaster-general of Newfoundland by which all matter relating to the exchange system shall be passed through the mails under frank of the Smithsonian Institution, the chief clerk of which certifies to the contents of each package.

Zoological Specimens for the Museum, contributed by Menageries.—For a number of years the Institution has been indebted to the proprietors of the menageries of the country for the contribution of animals dying from disease or otherwise while in their charge, the principal establishments in this connection being those of Messrs. Barnum, Bailey, and Hutchinson; Mr. Adam Forepaugh; the Central Park Menagerie, in charge of Mr. W. A. Conklin; and the Zoological Gardens at Philadelphia, under the direction of Mr. A. E. Brown.

From time to time specimens have been received in this way, and thus a large number of highly-prized additions have been made. The additional advantage of having them in the flesh in more or less perfect condition, enables them to be mounted under the best possible auspices.

In order to make some return to the contributors, the Institution offered to have post-mortem examinations instituted of specimens received, and the cause of death or disease reported to the senders. For this purpose the co-operation of the Army Medical Museum was invoked and was cheerfully rendered, and an examination of each subject received is usually made under the direction of Dr. John S. Billings.

The National Museum reserves the skins and skeletons, while the Army Medical Museum makes any preparations of the viscera, &c., that may be desired by it.

NECROLOGY.

From among those connected with the Institution, I have but one death to record.

EDWARD FOREMAN, M. D., was born in Baltimore, October 29, 1808. After reaching manhood, he was for 12 years an assistant professor in the University of Pennsylvania. In 1848, he was appointed an assistant in the Smithsonian Institution by Professor Henry. He was engaged in organizing the meteorological system established by the Institution, and rendered efficient service in this department; and also in conducting the correspondence and arranging the details of the scientific lectures. In 1852 he accepted the position of chief examiner in the Patent Office, which he retained for eight years. In 1874 he returned to the Smithsonian Institution as an assistant in the ethnological division of the National Museum. His death occurred April 14, 1885, at his residence in this city.

MISCELLANEOUS.

The Tyndall Trust Fund.—It will be remembered that when Prof. John Tyndall of the Royal Institution of Great Britain, at the solicitation of scientific friends in this country, made a visit to it in the latter part of 1872, for the purpose of delivering in a few of our principal cities courses of lectures on physical science, he very generously presented the entire net proceeds of his lectures to trustees for the purpose of promoting science in this country. These popular lectures, eloquently presented and admirably illustrated experimentally, were attended by large and appreciative audiences in Boston, New Haven, New York, Brooklyn, Philadelphia, Baltimore, and Washington.

Professor Tyndall's trust deed, executed in New York, February 7, 1873, just before his departure for England, was forwarded with a friendly personal letter of the same date, to Professor Henry of this Institution, and was published in full in the Smithsonian Report of 1872, pages 104–106. By this grant it was found that he assigned to our people the liberal fund of $13,033, in the following gracious terms,—omitting here all but the more essential passages:

> "As an evidence of my good-will toward the people of the United States, I desire to devote this sum of $13,033 to the advancement of theoretic science and the promotion of original research, especially in the department of physics, in the United States.
>
> "To accomplish this object I hereby appoint Prof. Joseph Henry, Secretary of the Smithsonian Institution, Washington City, D. C., Dr. E. L. Youmans, of New York, and General Hector Tyndale, of Philadelphia, to act as a board of trustees to take charge of the above sum—to carefully invest it in permanent securities; and I further direct that the said board shall, for the present, appropriate the interest of the fund in supporting or in assisting to support, at such European universities as they may consider most desirable, two American pupils who may evince decided talents in physics, and who may express a determination to devote their lives to this work. My desire would be that each pupil should spend four years at a German university—three of those years to be devoted to the acquisition of knowledge, and the fourth to original investigation.
>
> "If however in the progress of science in the United States, it should at any time appear to the said board that the end herein proposed would be better subserved by granting aid to students, or for some special researches in this country, the board is authorized to make the appropriations from the income of the fund for such purposes.
>
> "I further direct that vacancies which may occur in said board, by death or otherwise, shall be filled by the president of the National Academy of Sciences."

Even with the wise and far-seeing provision for discretion of judgment vested in the trustees by the donor, they experienced much greater difficulty in satisfactorily carrying into effect the enlightened purpose of the grant than could have been anticipated. One promising student, in the uncertainty of devoting his life to the career of scientific research contemplated, very honorably returned to the trustees the sum advanced to him. Another, after hesitating as to the condition of remaining for four years in a German or other European university, finally declined to avail himself of the opportunity afforded him. It thus resulted, from the conscientious administration of the trust, and the earnest desire of the trustees to execute the expressed wishes of

Professor Tyndall, that but a small portion of the income of the fund has been expended, and the original sum has been thereby augmented.

On the death of two of the trustees—Professor Henry, at Washington, and General H. Tyndale, at Philadelphia,—Dr. F. A. P. Barnard, of New York, and Prof. Joseph Lovering, of Cambridge, Mass., were duly appointed as their successors; and how judiciously the trustees have continued to husband the resources committed to them is sufficiently evinced by the remarkable fact that the Tyndall fund has now accumulated, by the constant addition to it of the unappropriated income, from the original sum of $13,000, to $32,000.

Under these circumstances the distinguished donor has been induced to modify the original conditions of the gift, so as to divide the increased principal into three separate funds (of nearly $11,000 each), and to give the charges thereof, respectively, to Harvard College at Cambridge, Columbia College at New York, and the University of Pennsylvania at Philadelphia, for the perpetual maintenance in each of these institutions of learning, of a graduate fellowship in the department of physics. There can be little doubt that this change of the direction was, under the peculiar circumstances, eminently judicious; and that the several endowments will constitute brilliant prizes to aspiring American students, and will greatly contribute to the noble purpose of their founder—the stimulation of original research, and the advancement of physical science in the United States.

UNITED STATES NATIONAL MUSEUM.

Arrangement of material.—The regular work of the Museum has been considerably interrupted during the six months now under consideration by the participation of the Museum in the World's Industrial and Cotton Centennial Exposition at New Orleans. Several members of the staff were in attendance at this exposition, in custody of the collections of the Museum there displayed, and in May and June ten curators and mechanics were sent to New Orleans to attend to the re-packing and forwarding of the collections sent by the Smithsonian Institution, as well as to care for the numerous exhibits transferred to the Museum by foreign and domestic exhibitors at the close of the exposition. The extent of these accessions was very considerable. One hundred and seventy-six thousand pounds of exhibits were sent to New Orleans. Of this amount 138,624 pounds were sent direct, 19,814 pounds from Cincinnati, and 17,631 pounds from Louisville, at each of which places the Smithsonian Institution had displayed large exhibits during the summer of 1884 320,744 pounds were returned, including 51,267 pounds received from the State Department, whose valuable exhibit, gathered by the United States consuls all over the world, was transferred in bulk to the National Museum with the understanding that a limited number of loan exhibits were reserved for return to their owners. Besides this amount, 74,489 pounds were acquired by gifts from Mexico and other sources. In addition to the collections consigned directly to the Museum from New Orleans, the important collection illustrating the uses of American woods, gathered for the exhibit of the Agricultural Department by Mr. William Saunders, has, since its receipt in Washington, been delivered to the Museum. At the beginning of July a considerable portion of the collections had already been received, and many of the exhibition halls of the Museum, which before this time had been reduced to an appearance of order, were becoming filled up with the unopened boxes and cases. It is however confidently expected that before the end of the calendar year the new material will be unpacked and brought under control. A special appropriation of $7,500 was made by Congress for the packing and forwarding of the new material, and for repairing and reinstalling the original collection. The New Orleans Exposition, although its influence was perhaps less comprehensive than that at Philadelphia in 1876, has nevertheless accomplished a great work in the South and West, both from commercial and educational standpoints, and in my judgment the money appropriated for the display of the Smithsonian Institution (including the United States National Museum and Fish Commission) has been productive of important results to the country. There can be no doubt that the National Museum has been the gainer by the undertaking, although the work of final arrangement has received a temporary set-back.

The general work of the Museum has been for the most part of the same character as that described in my reports for the last three years, and in nearly every department the curator states that decided progress has been made in the development both of the study and the exhibition series of specimens. The work of case-construction has been steadily carried forward, and during the coming year the collections will be more thoroughly classified than has hitherto been possible, by the assignment of definite space for each department in the exhibition halls. The galleries of the main exhibition hall in the Smithsonian building have been cleared of the old exhibition cases, which proved to be inadequate to present needs, and the space is being used temporarily for the overhauling and arrangement of certain large collections in the departments of birds, mollusks, marine invertebrates, invertebrate paleontology, and ethnology. This step has been found absolutely necessary, since the space in the crowded laboratory rooms was not sufficient to admit of any general rearrangement.

Museum Publications.—The various publications of the Museum have been, as hitherto, under the editorial supervision of Dr. Tarleton H. Bean. The seventh volume of the "Proceedings" was finished in February, and of the eighth volume, the printing of which was begun in March, 221 pages were printed prior to the 1st of July. At the present time four Bulletins are in the hands of the printer, No. 23, "Bibliography of the Publications of Isaac Lea, LL. D., by Newton Pratt

Scudder: No. 28, "A manual of American Land Shells," by W. G. Binney: No. 29, "Results of Ornithological Explorations in the Commander Islands and in Kamtschatka," by Leonhard Stejneger, and No. 30, "Bibliography of Publications relating to the collection of fossil invertebrates in the United States National Museum, including complete lists of the writings of Fielding B. Meek, Charles A. White, and Charles D. Walcott," by John Belknap Marcou.* Circular 32, "Classification of the Materia Medica Collection of the U. S. National Museum, and Catalogue of Specimens," by Dr. James M. Flint, revised and extended by Dr. Henry G. Beyer; and Circular 33, "Notes on the preparation of rough skeletons," by Frederic A. Lucas, have also been published.

The publication of the special report upon the fisheries of the United States, in quarto, which, in addition to its descriptive, historical, and statistical contents, will in reality constitute a monograph of the American portion of the fisheries collection in the Museum, has been going through the press under the supervision of the Assistant Director and Mr. A. H. Clark, who are rendering this service to the Fish Commission as volunteers.

Museum Library.—The accessions to the Museum library, including books and pamphlets, have been 454. Early in the year Mr. H. W. Spofford was appointed assistant to Mr. F. W. True, the librarian.

Visitors.—The total number of visitors to the National Museum during the first half of 1885 was 107,365, a daily average of 692$\frac{5}{9}$.

Meetings in the Lecture Hall.—The lecture hall, as in previous years, has been used for the meetings of several societies, viz, the National Academy of Sciences, the American Fisheries Society, the Biological Society of Washington, the Society of Naturalists of North America, and the Entomological Society of Washington.

Saturday Lectures.—Twelve Saturday lectures, under the auspices of the Biological and Anthropological Societies of Washington, were delivered in the lecture hall on successive Saturday afternoons, and were well attended. Many of these lectures had direct reference to the work of the Museum, and were illustrated by specimens from the cases.

Museum Report.—A special report upon the Museum having been ordered by Congress, the reports of the Assistant Director and curators for the year 1884, together with the accompanying statistics and the scientific papers based upon the collections in the National Museum, have been in a measure separated from the regular Smithsonian report, forming Part II of the same, and being arranged in a separate volume.

In accordance with my custom in previous years, I shall here present a brief review of what has been accomplished in each department, referring to the special Museum report for the full discussion of the additions to the Museum during the first half of 1885, and of the general administrative details of the work of the several executive officers.

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*These form Parts II and III of "Bibliographies of American Naturalists," and are shaped in reference to the long contemplated scheme of publishing a complete bibliographical record of all papers relating to the collections in the National Museum.

Organization of the Scientific Departments.—The organization of curatorships in the several scientific departments is as follows: I, arts and industries, the assistant director, G. Brown Goode, acting as curator, divided into the following sections: (*a*) materia medica, H. G. Beyer, U. S. N., honorary curator; (*b*) textile industries, Romyn Hitchcock, acting curator; (*c*) fisheries, R. Edward Earll, curator; (*d*) animal products, R. Edward Earll, acting curator; (*e*) naval architecture, J. W. Collins, United States Fish Commission, honorary curator; (*f*) foods, W. C. Atwater, acting curator; (*g*) historical relics, at present under the charge of A. H. Clark. II, A, ethnology, Otis T. Mason, curator, and II, B, American prehistoric pottery, William H. Holmes, Bureau of Ethnology, Smithsonian Institution, honorary curator. III, antiquities, Charles Rau, curator. IV, mammals, Frederick W. True, curator. V, A, birds, Robert Ridgway, curator; and V, B, birds' eggs, Charles Bendire, U. S. A., honorary curator. VI, reptiles and batrachians, H. C. Yarrow, U. S. A., honorary curator. VII, fishes, Tarleton H. Bean, curator. VIII, comparative anatomy, Frederick W. True, honorary curator. IX, mollusks, William H. Dall, honorary curator; X, insects, C. V. Riley, honorary curator; XI, marine invertebrates, Richard Rathbun, curator. XII, A, invertebrate fossils, (paleozoic,) C. D. Walcott, United States Geological Survey, honorary curator; and XII, B, invertebrate fossils, (meso-cenozoic,) C. A. White, United States Geological Survey, honorary curator. XIII, A, fossil plants, and XIII, B, recent plants, Lester F. Ward, United States Geological Survey, honorary curator. XIV, minerals, F. W. Clarke, United States Geological Survey, honorary curator. XV, lithology and physical geology, George P. Merrill, acting curator. XVI, metallurgy and economic geology, Fred. P. Dewey, curator. The departments of exploration and field-work, chemistry, experimental physiology, and vivaria are still unorganized. These twenty-seven departments and sections are administered by twenty-four curators, honorary curators, and acting curators, of which number at present only nine receive salaries from the Museum appropriation. Of the remaining fifteen, five are officers connected with the Geological Survey; one, an officer of the Bureau of Ethnology; two, officers of the Fish Commission; two, officers in the United States Army; one, an officer in the United States Navy; one, an officer in the Agricultural Department; and one, professor of chemistry in Wesleyan University; the remaining two are Museum officers, but receive no salaries for their work in administering upon the special collections under their charge.

Department of Arts and Industries.—In the department of arts and industries several sections have already been organized; that of Materia Medica, under the charge of Dr. H. G. Beyer, U. S. N., who has been detailed for this service by the Surgeon-General of the Navy, is in excellent condition, and the collection is the most extensive of its kind in America. The work of labelling has been finished, and during the year the exhibition series will be extended and rearranged. Dr. Beyer is prosecuting a chemical investigation of the different species of cinchona barks in the collection, numbering over one hundred, and has made some important determinations of the alkaloids of some cinchona barks from new regions in Guatemala and Costa Rica. He has also carried on investigations upon the physiological actions of atropia, cocaine, and caffeine, on the circulatory apparatus, the results of which have already been published in the "American Journal of the Medical Sciences." Other experiments on the action of atropine on the heart and of blood at different temperatures on the same, have been discussed in the Proceedings of the Museum.

In the section of foods, under the honorary curatorship of Professor Atwater, some progress has been made in the work of building up a collection illustrating the physiological action of foods and the composition of the human body, similar to the famous collection in the Bethnal Green Museum, in London. Mr. Hitchcock, who is acting curator of this collection, has, however, devoted most of his time to the development of the section of textiles, which is directly under his charge. This section has been largely increased by donations from abroad, but especially through collections made by himself while preparing for the Exposition at New Orleans. The object of these collections is twofold, first, to afford an exhibit of the various textile fibers available for use in this country and abroad, with specimens of articles made therefrom, such as cloth, rope, twine, mats, &c.; second, to provide a series of specimens of every fiber that can be used in the arts, to be used for scientific examination, tests of tensile strength, and especially to serve as type specimens for the identification of other fibers by microscopical examination. A number of collections which have been received are worthy of special mention. Among these, a particularly fine set of fibers from Brazil, collected by Dr. J. Carlos Berrinni, of Quissaman, who has devoted unusual care and labor to the work. All the textile fibers in the Museum of the Department of Agriculture were placed in Mr. Hitchcock's charge during January, and from this collection some valuable specimens have been selected and placed on exhibition. Mr. George W. Bond, of Boston, has selected a large collection of native and foreign wools from samples belonging to the United States customs department which have been prepared for exhibition; they are not yet on exhibition, as the cases for their display have not been made. This collection is probably already the best thing of the kind to be found in any museum, and when all the wools belonging to the Museum collections are mounted, the display of this textile will be, if not quite complete, at least very large and valuable. Owing to the restricted floor space in the Museum which has been assigned to this department, it has been impossible to make the display of specimens as instructive and attractive as it might be. By far the greater part of the collection, and some of the most interesting specimens, have been sent to the Exposition at New Orleans, where this department was well represented. A detailed account however of the display there made would not be of interest in this report, and the subject may be passed over with the statement that there were sent to New Orleans 290 unit boxes to represent the textiles department of the Museum. The display is said to have been very attractive. Mr. Hitchcock has also been requested to take charge of the physical apparatus belonging to the Smithsonian Institution which has been transferred to the National Museum and placed in cases. The arrangement has been necessarily very unsystematic, owing to the limited space at his disposal, but in a general way it is classified under three heads, namely, apparatus for experiments on (1) sound, (2) heat and light, and (3) electricity. A list of the instruments in this collection (which is of interest as having been used by Professor Henry) is in course of preparation. In connection with it may be mentioned the relics of electrical and chemical apparatus of Dr. Joseph Priestley, which is on exhibition in the same place.

The collection of historical relics has received but little attention during the six months, and no effort is at present being made to increase its extent. Perhaps no part of the Museum is more attractive to visitors than that in which the relics of General Washington are displayed, and it is believed that the section of historical relics will receive from year to year a constant increment of valuable memorials of the past. The heirs of General Robert E. Lee have presented a claim for the recovery of articles of furniture removed from Arlington in 1862, and since then on exhibition with the Washington relics at the Patent Office and in the Museum. Most of these appear never to have been the property of General Washington. They will however be held in the Museum until official instructions for their delivery have been received.

There has been little activity in connection with the section of fisheries, the section of naval architecture, and the collection of musical instruments, all of which are however in excellent order and have been considerably extended, though without direct effort.

An illustrated catalogue of the Catlin collection of Indian paintings has been prepared by Mr. Thomas Donaldson, and will soon be offered for publication.

Mr. J. E. Watkins, of Camden, N. J., who is one of the leading authorities in the country upon the history of railroads and steam transportation, and who is indorsed by many of the leading railroad men of the country, was appointed in June honorary curator of the section of steam transportation. It is intended, as opportunity offers, to gather in the Museum a collection of objects illustrating the history of American railroads and steamboats, with a view to preserving permanently the memorials of the growth of this most important interest which has been so closely connected with the material progress of the United States. Several important specimens have already been received, notably the "John Bull" locomotive engine, which was built in 1831 in England by George and Robert Stephenson for the "Camden and Amboy Rail and Tramway Company," by which this engine was used from 1831 to 1861. This is now stored at the Armory building, but will be placed on exhibition as soon as proper space can be provided.

Department of Ethnology.—The Curator of this department, Prof. Otis T. Mason, having gathered the ethnological material belonging to the Museum during the last half of 1884, commenced in 1885 its methodical arrangement. The basketry, throwing-sticks, sinew-backed bows, and the whole series of arrows, have been studied and classified, so as to illustrate their distribution, tribal characteristics, and evolution. It is designed to continue this system in the remaining portions of the collection, with the view of better unfolding through the arts of savagery the origin and development of civilization.

During the past six months the Curator made two official visits to the New Orleans Exposition, for the purpose of securing for the National Museum some of the material exhibited by the Departments of the General Government and of foreign countries. By this means the Museum has obtained a large number of accessions. Material of especial value was also received from Rev. C. H. A. Dall, of Calcutta; Rev. Dr. George W. Samson; Mr. James Stevenson, of the Bureau of Ethnology, and others, which will be fully described in the Report on the National Museum.

Mr. William H. Holmes, of the Bureau of Ethnology, has continued the installation of aboriginal pottery, directing his efforts chiefly to labelling, cataloguing, and classifying the accessions received in the summer and fall of 1884. The very extensive collections of Pueblo material made for the World's Industrial and Cotton Centennial Exposition in New Orleans, arrived too late to be made fully available for exhibition, but a small representative series of vessels and other objects of clay was forwarded to New Orleans. The collection of ancient pottery, recently obtained from Chiriqui, Panama, and partly paid for from the exposition funds, was also represented. The most important accessions have been from the explorations of Mr. L. H. Aymé, in Mexico. It is hoped that a portion, at least, of the pottery court will be opened to the public by the end of the present calendar year.

Department of Antiquities.—Dr. Charles Rau has continued his work in the department of antiquities, carrying on toward completion the system of arrangement which he began ten years ago. He reports important accessions from the Bureau of Ethnology; from explorations of Edward Palmer in Arizona; from Oaxaca, Mexico, by L. H. Aymé; from Costa Rica, by J. C. Zeledon; and from the island of Guadaloupe by L. Guesde. An exceedingly valuable collection of casts of the antiquities of Mexico and Yucatan has been deposited in the Museum by Señor

Eufemio Abadiano, of Mexico, by whom they were made. This collection includes full-size reproductions of several exceedingly important objects, such as the Mexican Aztec Calendar Stone, the Sacrificial Stone, the Aztec Goddess of Death (Teoyoamiqui), and the wonderful reclining figure of Chac-Mool. This collection has been forwarded from New Orleans and will soon be on exhibition, and it is hoped that by some means it may ultimately become the property of the Museum. It will be installed by the side of the Lorillard collection and other Central American antiquities. These two collections of casts, together with the originals already in possession of the Museum, will entirely fill one of the small exhibition galleries and constitute a display of native American sculpture and architecture which is equalled nowhere else in the world.

Department of Mammals.—At the beginning of the year the work of the mammal department, incident upon the preparation of a collection to be exhibited in New Orleans, having been entirely completed, the regular routine work was resumed. The mammal exhibition hall had been rendered less attractive than formerly by the removal of numerous large specimens for the New Orleans Exposition, and a temporary rearrangement of the collections was attempted in order to make the vacancies less conspicuous. During the first quarter of the year thirty-three mounted specimens were added to the exhibition series, including several large forms, such as a Siberian sheep, a baboon, &c. A list of all the mounted mammals was made in February, and soon afterwards temporary labels were written and distributed among the specimens. Manuscript for printed labels for the entire series was also prepared.

In April the director of the Museum offered a reward for the capture of a specimen of a spotted dolphin, said to be abundant in the Gulf of Mexico. A fresh specimen was soon afterwards received through Messrs. Warren & Stearns, of Pensacola, Fla., and proved to be of remarkable scientific interest. On the 9th of April three telegrams were received from life-saving station keepers announcing the stranding of cetaceans, two having reference to blackfish stranded near Cape Henry, and the third to a fin-back whale ashore near Truro, Mass. The most interesting cetacean specimens received during the half-year were a male pygmy sperm-whale (*Kogia*) and the skull of an Atlantic right-whale (*Balæna cisarctica*).

Messrs. Barnum, Bailey, and Hutchinson, Mr. Adam Forepaugh, and the authorities of the Philadelphia Zoological Gardens (through Mr. A. E. Brown), and the Central Park Menagerie (through Mr. W. A. Conklin), have continued to send many interesting animals in the flesh.

In June the chief taxidermist was ordered to New Orleans to superintend the packing of the mammals exhibited in that city. During his stay he negotiated an exchange in behalf of the Museum by which three valuable species of quadrumana were acquired, including a specimen of the interesting gibbon, *Hylobates concolor*. The New Orleans exhibit was not received at the Museum until after the 1st of July. (For a detailed account of this collection see Museum Report, 1884, p. 129.)

At the beginning of the year an office and a commodious laboratory in the southwest pavilion of the Museum building were assigned to this department. The collections are thereby made more accessible than formerly.

Department of Birds.—Mr. Ridgway, curator of birds, reports that by direction he prepared for exhibition at the New Orleans World's Cotton Exposition a collection of North American game birds, numbering 163 finely mounted specimens, and representing nearly all the species. The exhibit was at first intended to be much more comprehensive, the original plan being to exhibit all the known species of North American birds, so far as they could be secured, together with typical groups to illustrate the avian fauna of the several zoo-geographical divisions of the earth's surface. To this end more than 700 specimens were mounted on special contract, it being impossible to make up a suitable collection from the birds already mounted. The collection had been nearly completed on the original plan when it became necessary, on account of the limited space available, to make the great reduction which ensued. This collection was installed by Dr. Leonhard Stejneger, assistant curator, who for the purpose left Washington January 3, and returned on the 16th of the month. Dr. Stejneger reports that "in regard to completeness, perfection of mounting and preservation, scientific exactness, and popular instructiveness," this collection "was superior to any other ornithological exhibit at the exposition." The collection filled two double Museum cases, fitted with two rows of terraced shelves, the exhibition surface amounting to a little over 600 square feet. Each specimen was mounted on a stand of polished black walnut, and provided with a printed label on which were printed in large, clear type both the scientific and popular names. The curator also calls attention to the "American Ornithologists' Union," which was formed at the urgent request of the various ornithological interests of the country for the main purpose of harmonizing existing differences in the nomenclature of North American birds, and thereby removing the most serious obstacle to the study of ornithology. At the meeting of organization in New York City a "committee on classification and nomenclature" was formed, of which the curator of the department of birds of the United States National Museum was made a member; and this committee, in pursuance of a call from the chairman, held a meeting in Washington, from the 15th to the 23d of April, inclusive, in the office of this department, the collections of which were appealed to in all cases where there was a difference of opinion among members of the committee, and many perplexing problems were settled to the satisfaction of the committee as a whole. The importance to ornithology of this meeting, together with one held the previous year in the office of this department. can scarcely be overstated, the whole subject of zoological nomenclature having been exhaustively reviewed and a carefully prepared code adopted, in which the satisfactory rules of the existing codes were adopted and their unwieldy provisions rejected. This new code has been the guide of the committee in the preparation of a new list of North American birds, and will, without much doubt, be adopted by zoologists generally. The curator having been charged by the above-mentioned committee with the determination of names of North American birds according to the new code of nomenclature, this duty has been carefully performed, and the copy for the new list put in the hands of the president of the union. At this date the list is being printed. The naturalists of the United States Fish Commission steamer Albatross having made an extensive collection of birds on the almost unknown island of Cozumel, off the coast of Yucatan, it became the duty of the curator, as a part of his official work, to determine the species and describe those which proved new to science. The latter were no less than nineteen in number, of which the greater part have already been published, while the remainder are described in a full report upon the collection now being printed as a part of Volume VIII of the "Proceedings of the National Museum." The offer of the mounted birds—which had for some years been on exhibition in the museum of the Department of Agriculture, having been accepted by the National Museum, the transfer of the specimens to the Smithsonian building was effected during the month of May. This collection, numbering 712 specimens, consisted largely of common North American birds, the mounting of which was not up to the standard required for exhibition in the Museum collection. Being however suitable for purely educational purposes, this surplus stock is at present being made up into sets for distribution to schools or other public educational establishments which may require such material. The remainder of the collection, consisting of a very good series of the different varieties of the domesticated fowl and a smaller number of specimens of exotic Phasianidæ, has been properly arranged for exhibition in the Museum cases. Mr. Ridgway reports the accession of 3,681 specimens of birds and 185 specimens of nests and eggs.

Department of Fishes.—Dr. Tarleton H. Bean, curator of the department of fishes, reports 297 entries on the catalogue. The most important collections were made, as usual, by the vessels of the United States Fish Commission. The Albatross collections which are discussed in the Museum report are very large and important. The curator was aboard this steamer from the 3d of January to the 20th of February, during her work off the southern coast, and in the West Indies, Caribbean Sea, and the Gulf of Mexico, up to the time of her arrival at New Orleans. He was sent out to make observations upon the living specimens of the deep-sea fishes and upon the southward range of the east coast food-fishes. During the week spent at the island of Cozumel he had opportunity, incidentally, of aiding Mr. Benedict in securing a large series of the birds of that island, while the seining for fishes along the shore yielded 57 species. At New Orleans a short time was spent in attaching descriptive labels to casts of fishes in the Exposition.

Department of Comparative Anatomy.—This department is under the care of Mr. F. W. True, curator of mammals. Early in the year a number of exhibition cases were set up in the east south range, and in the latter part of February a provisional arrangement of the exhibition series of vertebrate skeletons was effected. A month later the entire collection of bird skeletons was brought from the Smithsonian building and stored in the range. An arrangement was made with the authorities of the Army Medical Museum for the exchange of a collection of human skulls for skeletons and skulls of North American vertebrates, and in April the first in stallment, consisting of about 500 skulls and 350 skeletons of North American vertebrates, was transferred to the United States National Museum. An agreement was also entered into between the Army Medical Museum and the National Museum to undertake post-mortem examination of animals in the flesh received by the Institution, and of which the donors desired to know the cause of death. A series of casts of bones of *Dinoceras*, presented by Prof. O. C. Marsh, was also placed on exhibition. The osteological preparator and his assistant were constantly engaged in cleaning skeletons and mounting them for exhibition. One of the most interesting of the recently exhibited skeletons is that of *Rhytina gigas*, obtained in Bering Island by Dr. L. Stejneger for the Institution. Some progress has been made in the preparation of a series of specimens illustrative of the modifications of the limbs and other portions of the skeletons in the different classes of vertebrates. Experiments in special cases for the exhibition of this and other similar series have proved very successful. But little work has been done in connection with the reserve series except for the purpose of determining whether the specimens were in good order.

Department of Mollusks.—This department has been making extraordinary progress under the charge of Mr. William H. Dall, assisted by Dr. R. E. C. Stearns. Mr. Dall reports that the department under his charge has been making steady advance in its administration upon the mass of accumulations of the last ten years, and, except in regard to the New Orleans exhibit, has little more to offer than a record of such uneventful work which is indispensable for making the collections useful for the paleontologist or the conchologist who may desire to consult it. The most interesting accession was a small lot of Japanese shells contributed by Mr. Uchimura, which contains several great rarities. The preparation of material for the New Orleans Exposition, which absorbed several months' time prior to the beginning of the year, was completed under the direction of Dr. Stearns, so that the boxes containing the specimens and the cases required for their display reached their destination and were ready for arrangement early in January. About the middle of the month Dr. Stearns proceeded to New Orleans and remained there until the installation of this exhibit was completed. The exhibit in this division of natural history probably surpassed, in extent and general excellence, any previously made at any great Exhibition. It was arranged in 21 table-cases, the specimens being placed in inside trays and labelled. The general system followed was a geographical one, and presented a characteristic representation of the more conspicuous and interesting forms of the various zoological-geographical provinces. The exhibit included several cases of the fresh-water mussels of the Mississippi drainage area, which is remarkable for the great number and beauty of the shells; also the rare and peculiar forms belonging to this group from other parts of the world. The land and pond snails of the Mississippi basin were each represented by a separate case. The marine shells of the Atlantic coast of America from the Arctic Sea to the Caribbean, and the sea-shells of the Pacific coast from Bering Sea to Panama, were also shown, including the principal species inhabiting the tidal areas of Puget Sound to the north and the Gulf of California to the south. Other cases contained selected specimens from the Indo-Pacific region, such as live in the warm waters of the great coral areas of the tropical and semi-tropical seas between the shores of Western America and Eastern Asia. Four cases were devoted to the edible mollusca of the United States. Two of these contained clams, cockles, &c., of the Atlantic seaboard, and two cases were devoted to similar forms peculiar to the coast of Western North America from Alaska to San Diego, Cal. The systematic and critical selection of the foregoing involved a great deal of work and the overhauling of a large quantity of material, the accumulation of many years. This labor was however incidentally advantageous to the Museum, as a considerable portion of the work consisted in the examination and partial preparation of molluscan material, hereafter to be incorporated in the national collection, and of very great importance for reference in connection with the study of fossil forms of the Quaternary or even of the Tertiary age. Unlike the results to some other departments of the Museum, the Exposition contributed little or nothing to this section, and indeed the Museum was the only contributor of an important molluscan exhibit.

Department of Insects.—Prof. C. V. Riley continues to perform the duties of curator without assistance; but arrangements have been made for the appointment of a paid assistant curator for the next fiscal year. Professor Riley reports a number of important accessions, including a large collection of Coleoptera and Lepidoptera sent from Sikkim by the Rev. C. H. A. Dall, of Calcutta. A varied collection of insects was secured by the United States Fish Commission steamer Albatross from the West Indian region, and an important general collection of alcoholic material was received from Dr. R. W. Shufeldt, U. S. A., stationed at Fort Wingate, New Mexico. The most valuable addition to the collection during these six months, from a classificatory standpoint, however, was the dipterological collection of Mr. Edward Burgess, treasurer of the

Boston Society of Natural History, which was obtained by purchase; while the most valuable, from a popular and economic view, is the exhibit collection prepared for the New Orleans Exposition. This has been returned with little injury, and is only awaiting space for permanent exhibition in the Museum. It is made up of the following material, arranged in cases made on the same unit plan as those of the Museum:

(1) *Insects injurious to Agriculture.*—Arranged according to the particular plant and the particular part of the plant affected, and containing, as far as possible, the different states of growth of the insect, its enemies and parasites, a statement of the remedies or preventives available, and a reference to the chief articles where full information can be found upon it. These references are principally to Government and State reports, to which the farmer will most likely have access.

(2) *Insecticide Substances.*—In the catalogue of this collection the aim has been to add, as briefly as possible, a statement of the method of using such substances, so that whenever in the first section a particular substance is recommended for a particular insect, the reader can turn to this second section for further details.

(3) *Insecticide Machinery and Contrivances for Destroying Insects.*—In the catalogue of this section there is also added such information as will add to the instructive value of the exhibit, and a large proportion of the more useful contrivances are such as have been designed and perfected in the work of the entomological division, or of the United States Entomological Commission during the past five years.

(4) *Bee-culture.*—This collection is designed to show all the more valuable methods and contrivances now in use among the advanced apiarians.

(5) *Silk-culture.*—In this collection the aim has been to make the exhibit instructive rather than full in detail. The collection includes, in addition to the foregoing, a number of framed plates, both colored and plain, which have been prepared in the work of the division; and a number of Prof. Riley's enlarged colored diagrams of some of the more important injurious insects were also used. A catalogue of this exhibit has been published under the direction of the Department of Agriculture, giving a full and detailed statement of its contents.

The routine work of the department has consisted in answering letters and in acknowledging and determining accessions. A good deal of work has also been done in the proper arrangement and classifying of material, particularly in the Micro-Lepidoptera and in the Lepidoptera generally. In this work Professor Riley was assisted by Mr. Albert Koebele, who was detailed from the Department of Agriculture for the purpose.

The researches in entomology have been made chiefly in connection with Prof. Riley's work for the Department of Agriculture; and some of the results have been published in the bulletins and publications of said Department.

Department of Marine Invertebrates.—Mr. Richard Rathbun, curator, reports that the most important addition to this department was made by the United States Fish Commission steamer Albatross in April, on her return from a three months' cruise in the Gulf of Mexico, mainly spent in investigating the grouper and red-snapper fishing grounds off our southern coast. The collection turned over to the Museum was much larger and contained many more novelties than that made by the Albatross in the same region and the Caribbean Sea the previous year, and the unassorted materials filled nearly 1,000 packages of all sizes. Of most interest was a series of several hundred specimens of sea-lilies, mostly collected off Havana, Cuba, and representing the various stages of growth of two species of *Pentacrinus* and of one of *Rhizocrinus.* Over 30 species of Echini, or sea-urchins, were also contained in the collection, and other divisions of the Echinodermata, as well as the Cœlenterata, Crustacea, and Mollusca, were very fully represented. The bathymetrical range covered by these explorations extended from the shore level to a depth of 1,467 fathoms. Prof. A. E. Verrill, of New Haven, has transferred to the Museum over 1,000 packages of identified specimens resulting from the explorations of the Fish Commission in former years. Mr. Henry Hemphill continued his collecting on the Florida coast, begun the previous winter, until March of this year, and has contributed several cases of specimens belonging to many groups. The other principal accessions have been a fine series of the sea-urchins and star-fishes of the west coast of Mexico from Mr. A. Forrer, numerous specimens of Pacific corals and echinoderms from Dr. R. E. C. Stearns, and the collection of marine invertebrates made by Lieut. George M. Stoney, U. S. N., in Alaska, in 1884. Much progress has been made in the determination and cataloguing of specimens. Prof. Walter Faxon has completed his studies of the collection of cray-fishes, which is now the second in the United States in size and number of species, being exceeded only by that at the Museum of Comparative Zoology, Cambridge. It contains 46 North American species. The collection of echini, which holds the same relative rank, has also been almost completely identified, and other groups are being rapidly worked over. In June the west hall of the Smithsonian building, devoted to the exhibition of marine invertebrates, was opened to the public, and although the collections now displayed fill only the wall cases surrounding the room, they present a very creditable appearance, and all the groups belonging to this department are represented to a greater or less extent. The dried collections not on display have been mostly transferred to the northwest gallery of the main hall, which will also serve as a general work-room for the department. Soon after the middle of June the curator and his assistants left for Wood's Holl, Mass., to take part in the summer explorations of the United States Fish Commission.

Department of Invertebrate Fossils (*Paleozoic*).—Mr. Charles D. Walcott, honorary curator of this department, reports that his principal work has consisted in identifying and labelling a collection of Carboniferous fossils which were in the old Smithsonian collection. This work is now well advanced, and will soon be completed as far as identifying the species from the old records can be done. In the laboratory the time of the curator has been chiefly devoted to the preparation and study of the Cambrian faunas of North America. This has been done in connection with his work for the Geological Survey. A large number of types and a great quantity of specimens of described species will be added to the Museum collections as a result of this work. A number of minor accessions have been received from various persons throughout the country. A large addition was made to the collection in the latter part of 1884, a full discussion of which was presented in the report for that year, and another valuable contribution from the Geological Survey will probably be made in the latter part of the present year.

Department of Invertebrate Fossils (*Meso-cenozoic*).—Dr. Charles A. White, the honorary curator of this department, states that a number of important accessions have been received during the first six months of this year, and that some of them constitute new additions to the collection. Descriptions of these have been published in the various bulletins of the United States Geological Survey. The work of preparing the collections of the Museum has been in progress, and the installation of types has been commenced. Since the beginning of the year considerable space has been assigned to this department in the gallery of the Smithsonian Institution, and the work of preparing materials for exhibition has steadily progressed. The space in the southeast court of the Museum building is occupied by specimens belonging to this department which have been turned over by the Geological Survey to the Museum, and in this court the collections are prepared for installation.

Departments of Fossil and Recent Plants.—Prof. Lester F. Ward, curator, reports that the work of his department was exclusively confined to fossil plants until near the close of the year 1884, and no collections of recent plants were received until February last, when rooms were assigned to him for the purpose, and the large Joad collection from Kew was placed in his charge. With this Professor Ward joined his own collection, consisting of nearly 5,000 species. The two collections combined form a nucleus of not less than 14,000 species, including twice as many herbarium specimens for a future herbarium. He submits the following suggestion:

"All botanical collections have for many years been turned over to the Department of Agriculture, to be cared for by the botanist of that Department. When in 1881 I was requested to take charge of the fossil plants of the National Museum, and consented to do so, I perceived at once the great inconvenience which this arrangement would cause to the department of fossil plants. The collections of fossil plants were largely undetermined, and required to be studied and identified. Most of them were from recent formations, and represented types of vegetation still living, requiring constant comparison with the recent forms to be seen in herbaria. Even the installation and care of those that were named necessitated such comparison, and the difficulties of this nature that were encountered were very great. It was rarely possible to carry the fossils to the Department of Agriculture, and as it was usually necessary to search through large families of plants, the temporary transportation of the botanical specimens was still more impracticable. I therefore early began to urge the establishment at the Museum of a permanent collection of the plants still growing in America and other countries where the analogues of fossil plants were likely to occur. While I am highly gratified at the progress in this direction already made, as reported above, it must however be evident that only a beginning has thus far been made, and that the present collection of living plants is still very inadequate. The Joad collection represents chiefly the flora of Southern Europe, which is widely different from all Tertiary floras, and especially so from the Cretaceous and Tertiary floras of North America. The collections that I have made are exclusively American, and, so far as they go, are valuable aids to the study of American fossil plants, but they are, of course, too limited in extent to be trusted in critical cases. The parts of the world next after those in North America with which our fossil floras most closely agree, are Eastern Asia, the East Indies, Australia, and South Africa, and from all these vast regions scarcely any representatives are to be found in the present herbarium of the National Museum. It is therefore highly desirable, as a necessary adjunct to the department of fossil plants, and aside from the still greater desideratum of establishing a truly national herbarium at the Museum, that all reasonable efforts be made to enlarge and enrich the botanical collections."

The technical botanical work of the department has been intrusted to Mr. Frank H. Knowlton, who in addition to identifying and installing the material, has devoted much time to bibliographical research, and to the development of the sectional library. Very large collections have been made by Mr. A. L. Schott during the spring and summer months from the parks and gardens of the city. These collections are designed primarily to aid in the preparation of a catalogue of the ornamental plants of Washington, but while serving this purpose, they are at the same time valuable accessions to the herbarium and highly useful in connection with the study of fossil plants. In collecting and preserving these specimens Mr. Schott has shown great industry and skill. In addition to this work Mr. Schott has undertaken the preparation of a check-list of genera from the "Genera Plantarum" of Bentham and Hooker, of which about half the manuscript was completed at the end of June. The time of the curator was almost exclusively spent in the study and determination of fossil plants collected by himself, and over one hundred species, many of which are new, were identified and will be duly incorporated in the Museum collections.

Department of Minerals.—This department has been under the charge of Prof. F. W. Clarke, assisted by Mr. William S. Yeates. There have been made during the first half of the year 534 entries, representing 2,137 specimens, all of which are new accessions, except 138 specimens which were found in the old collections without evidence of having been previously catalogued. Eighteen sets of minerals have been sent out as exchanges, comprising about 1,200 specimens, and much valuable material has been obtained in return. This department was represented at New Orleans by collections of the minerals from which are obtained gems and ornamental stones, and also by a collection of cut and polished stones. These collections attracted the general attention of connoisseurs and visitors at the Exposition. The minerals were classified after Dana's system, and were arranged in seven flat-top table-cases. The gems were displayed in two cases, the specimens being mounted on white and black velvet pads. This department did not secure a large amount of new material from the New Orleans Exposition, most of the mineral collections on exhibition belonging to private individuals, to whom the agents were responsible for the safe return of their specimens. One-half of the southwest court has been assigned to this department as its exhibition space, and the collections have been removed thither.

Department of Lithology and Physical Geology.—The curator, Mr. George P. Merrill, was on duty at the New Orleans Exposition at the beginning of the year, but has nevertheless accomplished very satisfactory results in the work of reinstalling the collections upon the extended floor-space recently assigned to this department. The opening of the year found the affairs of this department in a quiescent though somewhat confused state, owing to the fact that since the preceding July the entire energies of the working force had been devoted to the preparation of the exhibit designed for the New Orleans Exposition, and the regular work of the Museum had consequently fallen behind. The special exhibit was completed late in December and the extra hands discharged. This exhibit consisted of (1) a collection of 358 specimens of building and ornamental stones of the United States in the form of four-inch cubes; (2) a collection of some 12 specimens of foreign and native marbles in the form of polished slabs; (3) a collection of 150 specimens of rock-forming minerals; (4) a collection called a "structural series," intended to represent all the common forms of rock structure and texture; (5) a collection of 198 specimens of rock illustrating the geology and lithology of the Comstock lode and Washoe district, Nevada; and (6) a lithological collection comprising 500 specimens of various rocks; this last together with numbers 3 and 4 forming a part of the regular educational series of the Museum. As these collections were all fully described in the report of this department for 1884, no further reference to them in this place is necessary. The large quantity of building-stone and other material occupying the space in the southwest court, was removed and stored temporarily in a shed outside the eastern entrance to the Museum, the court being thus available for exhibition purposes. By a reassignment of exhibition space, the exhibition area of this department was made to include the whole of the west-south range, instead of a portion of this range and a portion of the court, as heretofore. The new arrangement is vastly preferable both on account of the better light thus obtained and of greater convenience in arranging and classifying the exhibit. In May the force of the department was again increased by the addition of one aid, one clerk, and three stone-cutters, and the preparation of a collection of building-stones commenced for the American Museum of Natural History in New York. This collection will, when complete, comprise not less than one thousand specimens, and an equal number of thin sections for microscopical study. This work was still in progress at the end of June. The number of entries in the department catalogue during the six months has been 486, comprising some 700 specimens. These will be fully described in the Museum report for the first half of 1885. Considerable time has been devoted to the preparation of the various exhibition series, particularly those included under lithology, and historical, dynamical, and structural geology. The last three are as yet far from completion, and at the present rate of progress, which is necessarily very limited, must so continue for several years. On this point Mr. Merrill comments as follows:

> "I may, perhaps, be pardoned for mentioning here the fact that from past experience, I am convinced that the only satisfactory way in which these last-named branches of my department can be built up, is to allow the curator, or some experienced person, a certain sum of money to be expended either in the purchase of collections under his direct supervision, or of especially desirable material. A very considerable portion of the material now necessary for this purpose is of such a nature—principally on account of the bulk and weight of the specimens—as to be beyond the scope of the ordinary collector, and in too little demand to be found in many of the natural-history stores. I might mention such examples as fault structure, examples of folds, contortion, false bedding, &c., which can scarcely be obtained by other than the means suggested."

Department of Metallurgy and Economic Geology.—At the opening of the year the curator, Mr. F. P. Dewey, was still detained at New Orleans, arranging the collection which had been sent from his department to the Exposition, and he did not return to Washington till the middle of January. The design of the special exhibit of this department was to show, as far as the time and means at his disposal would permit, the prominent occurrences of each metal, the methods of extracting the metals from their ores, and the utilization of the metals. To these were added a few illustrations of non-metallic ores and their utilization, including a very extensive and valuable illustration of the coal industry. Most of the ore material was selected from the Museum collection, and only a very few new collections were made. These latter were taken upon a systematic plan representing the mine as a unit rather than to gather a few specimens selected at random, as is usually done. In following the plan, specimens were taken to represent sections across and up and down the vein, and to show an average of the product of the vein, while to these were added the walls and other interesting material. In representing the extraction and utilization of the metals, the plan adopted was to begin with the ore as it leaves the mine, and to follow it through the various steps in all the operations to the production of the finished article, showing, when possible, every material entering into each operation, as well as every product of each operation. In the case of coal, the collections were based largely on the ethnological aspects of the question, and thus included many specimens aside from those of an economic or geological value. Throughout the new collections of the department special attention has been paid to gathering as full and complete a description of everything shown as possible, while the pictorial side of the question has been treated very elaborately and includes some views of the interior of a coal mine taken by electric light, the first views of the kind ever produced. These collections form a basis for a full and complete representation of the mineral resources of the country, and it is hoped that they will increase until they shall have attained their highest educational value. They have been fully described in Museum Circular No. 31. The regular force of the department having been reduced to a scientific assistant and a laborer, the work of preparing the collections in the Museum has been at a comparative stand-still during the first half of the year. The laboratory of this department has been moved to the second floor of the southwest pavilion, and the work-room on the floor of the Museum has been cleaned out and space prepared for exhibition purposes, so that now the entire work of preparing material for exhibition has been concentrated into one place. The work of investigating the New Orleans material has been carried on as far as practicable, and, with the assistance of Mr. Allen, a number of very valuable analyses have been made. A large number of accessions have been received, among which may be specially mentioned a collection from the Argo works, presented by Hon. N. P. Hill, a series donated by the Copper Queen Company, and a series of apatite from many localities, presented by Pickford & Winkfield, of London, England. In the middle of May the curator returned to New Orleans to pack up the collection and to solicit contributions for increasing the value of the permanent collections. No attempt was made to obtain large, entire collections without regard to their value to the Museum, requests being made for material of only two classes, *i. e.*, that of intrinsic value, and such as would fill gaps in our permanent collections. This effort was so successful that much very valuable material was obtained and some of the most important gaps were filled. Among the former should be especially noticed the important and interesting collection received from Mexico, and among the latter the valuable series of iron ores from the Menominee region in Michigan. After the return of the curator to

Washington in June, the collection presented to the Museum by the American Institute of Mining Engineers, and which has for some years been stored in Philadelphia, under the care of Mr. Thomas Donaldson, commenced to arrive and claimed his attention during the remainder of the fiscal year.

BUREAU OF ETHNOLOGY.

For continuing the prosecution of ethnological researches among the North American Indians during the year 1885, under the general supervision of the Smithsonian Institution, an appropriation of $40,000 was made by Congress. The charge of this interesting work—so valuable for the advancement of anthropological knowledge—still remains under the efficient direction of Maj. J. W. Powell.

The explorations in this field for the collection of information and material, being mainly conducted during the summer months, the results cannot be collated and discussed till late in the fall. And as the present report is brought down only to the 1st of July, a notice of the operations of this Bureau for the year 1885 must necessarily be postponed until the next annual report.

UNITED STATES GEOLOGICAL SURVEY.

While this important branch of the public service is in its organization entirely independent of the Smithsonian Institution, yet its intimate relations to the latter, not only in the advancement of original scientific research, but particularly in the valuable contributions made by it to the stores of the National Museum, have seemed to justify an annual summary of its general operations. Maj. J. W. Powell continues to administer in a highly satisfactory manner the responsible duties of his position as Director of the Survey.

In this department also, as in that last referred to, the field work is still in progress at the closing of this report. And hence, for the reason assigned, no details of the work and its results can here be given. The character of the geological operations for the year will be concisely presented in the report of 1885–'86.

THE UNITED STATES FISH COMMISSION.

The work of the Commission has been prosecuted on about the same scale as during the year 1884, the usual attention being paid to the production of trout, salmon, whitefish, and other species, and to the general investigations into the fisheries of the country.

The steamer Albatross, which was sent to the Gulf of Mexico, partly to represent the United States Fish Commission at the New Orleans

Exposition and partly for the prosecution of research, was very successful in her mission, attracting much attention at the exhibition, and making many important explorations. Included in these was a short visit to Cozumel, an island off the coast of Yucatan, where many new species of vertebrate animals were secured.

The investigations made at Wood's Holl will be detailed in the next report, as the work was begun after June 30, which represents the limit of the present report.

Respectfully submitted.

SPENCER F. BAIRD,
Secretary Smithsonian Institution.

WASHINGTON, *July* 1, 1885.

REPORT ON SMITHSONIAN EXCHANGES, JANUARY 1 TO JUNE 30, 1885.

By George H. Boehmer.

OFFICE WORK.

On my return from an official mission to Europe as special agent for the international exchange of official public documents of the United States Government with foreign powers, to which position I had been appointed by yourself, and at the request of Mr. Spofford, the Librarian of Congress, on July 22, 1884, I resumed charge of the Exchange Office on March 1, 1885. One of my first duties was the preparation of reports to (1) the Smithsonian Institution, as the agent of exchange of the United States Government, and (2) to the Library of Congress, as the beneficiary under the Congressional act establishing this system of exchange. The latter report is a manuscript of 620 pages of (42-line) foolscap paper, and will in all probability be presented to Congress by the Librarian of Congress through the Joint Committee on the Library. The report to the Smithsonian Institution is a manuscript of over 500 pages foolscap, and comprises: (*a*) Letter of transmittal; (*b*) historical sketch of international exchanges; (*c*) journal; (*d*) correspondence; (*e*) bibliographical list of official and scientific publications made by the Government departments and scientific and learned societies located in Berlin, Germany. This list is as complete as could be collected during the comparatively short sojourn in that city. Of this report only the letter of transmittal, exhibiting a résumé in a condensed form of the work performed, success attained, and certain observations made abroad, will be given in the present statement, under the heading "Government Exchange Division."

Special attention had been given in all the countries visited to the collecting of reliable information and material to aid in the correction of the "list of foreign correspondents." In this endeavor I met with the most generous assistance on the part of all officials to whom I made known my wishes, and a full list of the co-operators in this enterprise will be presented in the new and revised list prepared from the material collected and now ready for publication. This new list comprises over 4,000 titles, while the last one published by the Institution had only 2,901.

The regular office work has received proper attention, and the first six months of the present year close with a record never attained before.

The Record Division.—The duties of this office have become so numerous, that an additional assistant was this year allowed. The work of this division now embraces all the records and card catalogues under the system adopted on the 1st of January, 1885. Under this system all exchanges, whether incoming or outgoing, foreign or domestic, after verifying the correctness of the sending, are entered on a blotter—this work being done by the assistants in the foreign and domestic exchange division, respectively; these blotters are then transcribed by the clerks of the record division in the day-book, from which the ledger, represented by a card catalogue, is posted. In addition to these duties, it devolves on the clerks of this division to prepare the invoices for the outgoing exchanges, and to credit on the ledger the acknowledgments sent by recipients of exchanges, and to record and file letters, bills of lading, &c.

The following statement exhibits the work done in this division during the first six months:

Description.	Number.
Foreign cards in use	3,375
Domestic cards in use	806
Domestic entries made	11,217
Foreign entries made	33,651
Invoices written	13,576
Government packages received	51,600
Miscellaneous packages received	14,042
Letters entered	433

The Foreign Exchange Division.—Since January 1, 1885, 39,921 packages have been received in this division and 383 boxes sent, including the Government exchanges. A comparative statement of boxes sent during corresponding periods of former years present the following results:

Boxes.	1880.	1881.	1882.	1883.	1884.	1885.
Number	72	155	168	166	350	383

The year 1884 exhibited an extraordinary increase in the transmissions, which was largely due to an arrangement for exchanges on the part of the United States Patent Office with foreign Governments by which 62 large cases were sent abroad through the Smithsonian Institution in June of that year. But notwithstanding this unusual sending, the last six months show an increase of 33 boxes over the similar period of 1884. A detailed list will be presented in the statistics of exchanges.

Owing to the large addition in the work required under the present system of preparing blotters, &c., and in consideration of the regular increase both in incoming and outgoing exchanges, two (temporary) assistants have been employed.

The Domestic Exchange Division.—The work performed in this division between January 1, 1885, and June 30, 1885, is as follows:

Description.	Number.
Total packages distributed	5,138
Announcements written	1,830
Addresses written	7,320
Entries made in blotters	5,138

While now, as compared with 1884, the number of packages distributed does not apparently present any marked increase, it must be remembered that until the end of August, 1884, all books for the Smithsonian Institution, whether received by mail or otherwise, were entered on the exchange record; but since then the books for the Smithsonian Institution, coming by mail, were sent direct to the Smithsonian Library without passing through the exchanges. Thus, while the number of entries on the exchange records has apparently remained the same, an increase has in reality taken place, the extent of which is represented by the number of packages sent direct to the Smithsonian Library.

VISIT TO EUROPE.

The Government Exchange Division.—On the 22d of July, 1884, having been appointed as special European agent of the Library of Congress for exchanging the official publications of the United States Government for like publications of foreign Governments, in accordance with the Congressional acts of March 2, 1867, and July 2, 1868, I venture to here present, as a concise statement of the business accomplished, a reproduction of the letter transmitting the formal report:

"Obediently to the instructions received, and provided with letters of credence (1) from yourself to the correspondents of the Institution abroad, (2) from Mr. Spofford, on behalf of the Library of Congress to the officers in charge of Government exchanges in Europe, and (3) from the Department of State to the officers of the diplomatic and consular corps of the United States in Europe, I left on my mission on the 24th of July, 1884, and successively visited the executive departments of the following countries: Germany, Prussia, Saxony, Denmark, Norway, Sweden, Finland, Russia, Austria, Hungary, Roumania, Bavaria, Switzerland, Wurtemberg, Belgium, Holland, England, Italy, and France (several of them repeatedly), obtaining immediate results far above all expectations, and securing the promise of further valuable returns. In most of the countries visited even the promise of two complete sets of official publications has been secured, while the Government of the United States furnishes only one single copy to each of the exchanging states. Austria has been added to the list of exchanging Governments, and Germany and Prussia are also expected to be represented in a decided majority of their respective publications.

"One of the paragraphs of instruction, specifying the kind of documents especially desired by the Librarian of Congress, mentions, among others—

"(*a*) Complete sets of the laws of each country.

"(*b*) Journals, &c., of parliamentary bodies.

"(*c*) Historical publications.

"In compliance with this paragraph I desire to state that on the part of all the Governments visited the promise has been cheerfully given (including even that of Germany and Prussia), and a number of them have already redeemed their promise. Large collections have been received from the Governments of Sweden, Norway, Denmark, Hungary, Saxony, Wurtemberg, Bavaria, Holland, Italy, France, and Switzerland, while in furnishing collections of laws those of Wurtemberg and Bavaria stand pre-eminent, the collection from the former extending from the year 1289 to the present day. This is not a Government publication, but a private enterprise. The complete work had to be purchased by the Government of Wurtemberg, and is now being presented to the Government of the United States in appreciation of the many and valuable documents presented under the Congressional act of Government documents exchange, while the collection from Bavaria comprises several hundred volumes. As regards historical publications the Government of Switzerland stands pre-eminent in her promise to supply as complete a collection as can be obtained—a library in itself—of the historical works of that Republic, while the Governments of Saxony and Italy have already furnished some very valuable works. Of other official publications a collection of 4,500 volumes of "Procès-verbaux des conseils généraux des Départements Français," received from the French Government, may be named, while the offer of the English Government of supplying the parliamentary papers from the year 1817 to the end of 1881 also deserves mention.

"At first I met with great difficulties and vexations in carrying out the designated plan of operations, mainly owing to the facts that all the intercourse had been in a very indirect way of correspondence, and that an agent of exchange had never visited the respective Governments, among whom some very singular ideas prevailed as to the true position of the Library of Congress as regards this exchange, as well as to its relative position to the Government of the United States and the bodies representing the Government in its various branches, and in consequence of which some very serious misapprehensions and misconstructions as regards the purpose of this exchange had occurred.

"Another disadvantage which soon became painfully noticeable has its origin in the entirely different organization and construction of the exchange service of the European countries as compared with our own system.

"While the United States Congress makes a liberal provision for the printing and gratuitous distribution of all official publications, from the most inexpensive to the most costly production, in European countries the respective governmental bureaus and departments relieve themselves of any and all annoyances and cost attending the printing and publishing of their various issues by giving the manuscript in commission to some enterprising and reliable publishing house. Thus the work is at once thrown in the book trade and represents a commercial value, and copies can only be supplied through the firm holding the work on commission. The department may receive probably some 50 per cent. of the proceeds of the sales, which income greatly lessens the cost of preparing the manuscript. The respective departments can obtain copies only by purchase, and no legislation existing in those countries like our Congressional act authorizing the exchange of official documents, the one bureau, having undertaken the collecting and providing for the exchange with other Governments, has a very difficult task in obtaining from the other departments the works required for the purpose. It has no right to demand, but it is always the supplicant for a favor, since such only it can be considered.

"Furthermore, the bureaus of exchange established (on the basis adopted by the Paris convention in 1875) in a number of European states are greatly restricted in their *modus operandi* by well-defined laws, which prescribe distinctly that the official publications obtained in the manner above described, and purchased from funds exclusively allowed for the purpose, can be exchanged only for works of the same (commercial) value. This, however, is a difficult matter in the case of the United States publications, which represent no commercial value, although they command very high figures in the book trade. I beg leave here to quote from an English catalogue the prices of some of the more important United States publications—the figures reduced to American currency:

Publications.	Prices.
Contributions to North American Ethnology, vol. 4	$11 25
Contributions to North American Ethnology, vol. 5	10 50
Annual Reports, Bureau of Ethnology ... per volume	12 50
U. S. Fish Commission Reports, 8 volumes	45 00
Tenth Census ... per volume, about	5 00
Tenth Census, vol. 8	15 75
Commercial Relations of the United States, 1880–1884 ... per set	27 50
Iron and Steel, 2 volumes	10 50
Annual Report Secretary of War, 1880 ... per set	10 50
Mineral Resources of the United States ... per volume	7 50
Mines and Mining ... do	7 50
Paris Exhibition ... per set	10 50
Black Hills of Dakota	18 75
Hayden Survey, 9 volumes, 4to	75 00
Hayden Survey, Annual Reports, 12 volumes	63 00
Hayden Survey, Atlas of Colorado	15 75
King Survey, Fortieth Parallel ... per set	157 00
U. S. Geological Survey (Powell), Annual Reports ... per volume	7 50
U. S. Geological Survey, monograph, vol. 2	21 00
U. S. Geological Survey, monograph, vol. 3	21 00
U. S. Geological Survey, monograph, vol. 4	7 50
U. S. Geological Survey, monograph, vol. 5	14 25
Wheeler, Surveys West of the 100th Meridian ... per set	130 00
Defenses of Washington	11 25

"Herein, and in the misconceptions above stated, we may find an explanation of the scant returns the Government of the United States has received and of the incompleteness of the series furnished; and though, through the kind and hearty co-operation of our diplomatic and consular officers, I finally succeeded in placing, for a time at least, the exchanges on a sound basis, allow me to suggest that the means of securing for the Government of the United States full returns for the liberal provisions made for the exchange, and of reaping the benefit of the promises obtained from the European Governments in the execution of my mission, can only be found in the establishment of a permanent agency in Europe, a precedent for which we find in the Congressional act of June 26, 1848, wherein Congress charged the Library Committee with the nomination of an agent to conduct the operations of the exchange between France and the United States, which ought to be intrusted to a person entirely familiar with the business and its requirements, who is to keep himself always informed as to the quality and quantity of the publications made by the European Governments, and who should be capable of judging and selecting from the works thus offered such as would compensate the Government of the United States in the fullest measure in an exchange, value for value, the value of the United States publications being accepted as they are quoted in the book trade, for the works sent abroad, in compliance with the Congressional acts establishing this exchange."

EXTENSION OF THE SYSTEM OF EXCHANGES.

With two Governments preliminary arrangements have been made for an exchange of official publications, the extent of which however has not yet been fully decided on. These Governments are those of the Republic of Uruguay and of the Empire of Austria. The correspondence relating to these arrangements is here given:

EXCHANGE WITH URUGUAY.

From Department of State, Washington, December 30, 1884, *to Prof. S. F. Baird, Smithsonian Institution.*

DEAR SIR: I inclose a copy of a note from the Chargé d'Affaires *ad interim* of Uruguay here, touching the wish of his Government to form (or accede to) conventions with other Governments, with a view to providing for exchanges of publications; also the printed paper which accompanies the same, and which it is desired to have returned, with your comments on the proposition of the Uruguayan Government.

I am, &c.,
FRED'K T. FRELINGHUYSEN.

Inclosure from legation of Uruguay, New York, December 14, 1884, *to the Secretary of State, Washington.*

SIR: I have the honor to address your excellency for the purpose of bringing to your notice, by means of the copy herewith inclosed, the invitation which the Government of the Republic that I represent has the high honor to address to you, for the purposes stated in the note. It extends this invitation feeling every confidence in the lofty American spirit and the good will of the United States Government.

I transcribe to your excellency, in full, the note whereby I am instructed to bring to the notice of your Government this invitation; it reads as follows:

"*Montevideo, October* 29, 1884.

"MR. CHARGÉ D'AFFAIRES:

"I send you a printed copy of the law recently passed by the honorable general assembly of the Republic providing for the establishment, in the national library, of a bureau which is to be called 'The Central Bureau of International Exchanges of Publications.'

"In pursuance of the provisions of article 8 of the reglementary decree of that law, you will be pleased to invite the Government to which you are accredited, in the name of the Republic, to conclude a convention for the exchange of publications on various subjects. Two objects are had in view by the Government in pursuing this course, viz, to draw still closer the cordial relations which exist between this Republic and that of the United States of America, and to encourage, by facilitating them as far as possible, the knowledge and study of literary, scientific, and other questions among the nations of America, whose advances in progress and civilization must speedily place them on a footing with the most progressive nations of Europe. Your superior enlightenment renders it unnecessary for me to advance any arguments in order to show the importance of the proposed convention, or the advantages which must accrue from it to the nations adopting it. If, as is to be hoped, the United States Government agrees to conclude the arrangement in question, it may be done on the basis of that which already exists between this Republic and Chili, or of that concluded by Belgium with various other nations, which you will find in the inclosed printed documents, if the United States Government does not consider that certain modifications are necessary, which the Government of this Republic is prepared to consider. You will be pleased to request that Government to send you a reply in regard to this matter.

"MANUEL HERRERA Y OBER."

In bringing the foregoing note to your knowledge, and inclosing the printed copy of the conventions to which it refers, permit me to hope that the cabinet of which your excellency is so distinguished a member will not consider the plan which I hereby have the honor to submit as impracticable, since it will tend to render better known in our country the practical details of the institutions of this, together with its advances, which so greatly stimulate our own, while the constant perusal of the publications of our Republic will show the eagerness with which American countries of Spanish extraction are seeking, in spite of well-known obstacles, to secure for themselves a permanent position among the nations of the modern world.

CARLOS FARINI.

Central Office of International Exchanges of Publications.

The Senate and House of Representatives of the Republic of Uruguay in general assembly, &c., resolve:

Article 1. There is established in the national library an office called "The Central Office of International Exchanges of Publications."

Article 2. The director of the library, through the intermediary of the office created by the preceding article, will proceed to effect the exchange of official publications, and of the literary and scientific works which are printed in the Republic, in conformity with diplomatic conventions in force, and those which the Executive may conclude with foreign Governments.

Article 3. The Executive will make the necessary regulations for the office created by this law.

Article 4. This is made known, &c.

House of Representatives, Montevideo, May 14, 1884.

X. LAVIÑA, *President.*
JOSÉ LUIS MISSAGLIA, *Secretary.*

House of Representatives of the Republic of Uruguay,
Montevideo, May 15, 1884.

To the Executive of the Republic:

We have the honor to transmit to the Executive of the Republic the law sanctioned by the honorable Congress in yesterday's session, establishing in the national library an office called "The Central Office of International Exchanges of Publications."

XAVIER LAVIÑA.
JOSE LUIS MISSAGLIA.

Department of State, Montevideo, May 27, 1884.

We have the honor to acknowledge the receipt of your communication, and to inform you that there has been forwarded to the director of the library the decree authorizing him to make the necessary regulations.

SANTOS.
CARLOS DE CASTRO.

Department of State, Montevideo, July 24, 1884.

DECREE.

In conformity with the provisions of article 3 of the law of May 27, 1884, the Executive of the Republic decrees:

Article 1. After the office of International Exchanges of Publications referred to in the preceding law has been established and organized, the director of the national library will, with the view to the better service of said office, prepare regulations for the same, which he will in due time submit to the Government for its approval.

Article 2. The above-mentioned functionary will on the 31st December of each year present to this ministry a report showing the progress, the needs, and the increase of said office, which document, when published, shall be transmitted to all institutions which exchange publications with the national library.

Article 3. All the departments and their bureaus will transmit to the office of International Exchanges of Publications 25 copies of all the documents published by them.

Article 4. The director of the national library will acquire for the office to which this decree relates, all such publications as will, in his opinion, tend to contribute to the reputation of the Republic in foreign parts, with the view that this office may distribute them. The provisions of this article, however, shall not interfere with any donations which may be made to the office of exchanges.

Article 5. All agents of the Republic in foreign countries will aid the director of the library, whenever he calls on them for such aid; and if such obligation involves any expenditure, the agents shall, before taking any action, inform the director of the amount needed, so that he may either allow the expenditure or refuse it, according to the amount of funds at his disposal for the purpose.

Article 6. Any conventions which may be concluded in the future shall be formulated according to the test of the convention concluded between the chargé d' affaires of Uruguay in Chili and the Government of Chili on the 6th June, 1873, and whenever this is impossible, according to the project of a convention prepared at Brussels on the 26th August, 1880.*

Article 7. In view of the fact that any delay in the conclusion of conventions may prove prejudicial to the Republic and the national library, the director of that institution will propose to the Department of State the establishment of an exchange of publications with all those nations with whom, in his opinion, such an exchange should be established, determining at the same time what publications should be exchanged. And if the Department of State approves of the proposition, it will transmit it to the Ministry of Foreign Affairs, which immediately, and without any legislation on the subject, will proceed to arrange the necessary convention, reporting its action to the Department of State.

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*[The articles of this convention were published in the Smithsonian Report for 1883, pp. 123, 124.]

Article 8. There shall be forwarded to all the Governments of America, through the intermediary of the Ministry of Foreign Affairs, a circular giving the provisions of the law in question and of this decree, inviting them at the same time to enjoy the benefits which will result from such an exchange for all nations which accept it.

Article 9. The above shall be published and inserted in the code of laws.

SANTOS.
CARLOS DE CASTRO.

Exchange of publications between Uruguay and Chili.

Met at the Ministry of Foreign Affairs on the sixth day of June, one thousand eight hundred and seventy-three, Don Jose C. Arrieta, chargé d'affaires of the Republic of Uruguay, and Don Adolfo Ibañez, minister of foreign affairs of Chili, for the purpose of concluding a convention for the regular and permanent exchange between the two Republics of the literary and scientific productions of their citizens, which will strengthen the bonds of sympathy which unite the two countries, and agreed upon the following articles:

Article 1. The Government of Uruguay and of Chili will send to each other, as soon as possible, two copies of all the publications which they have had printed in accordance with the provisions of the law in their respective territories, excepting productions of purely private interest or whose contents do not entitle them to be considered as scientific or literary publications.

Article 2. The same obligation will be in force even if the publications in question have not been published in either of the two countries, but have been published at the expense of either of the two Governments, or by their aid or subvention.

Article 3. As soon as one of the two Governments has received the publications sent by the other, it will acknowledge their receipt in the official journal, giving the place where they have been published and the place whence they were sent, with the view to bring them to the notice of those who desire to obtain them.

Article 4. The provisions of the above three articles will apply to geographical maps and other works of that character.

Article 5. Each Government will also procure and send to the other two copies of works published by citizens of their respective countries residing abroad; but this obligation will cease as regards the Government of Uruguay if a citizen of Uruguay publishes a work in Chili, and as regards the Government of Chili if a Chilian citizen publishes a work in Uruguay.

Article 6. Each of the two Governments will form a collection as complete as possible of all the works published within its territory, or outside of it, if the provisions of article 2 apply to them; and will transmit this collection to the other at as early a date as possible. This collection should especially comprise works treating of the history, geography, industries, statistics, and legislation of the country.

Article 7. Publications shall be transmitted in the month of January of every year; in Uruguay through the intermediary of the Chilian legation, and in Chili through the intermediary of the Uruguayan legation, or direct between the two Governments whenever there are no legations.

Article 8. The present convention will go into effect this day, and will continue in force, until either of the two Governments shall desire its discontinuance, and shall so advise the other.

At the close of this conference the chargé d'affaires of Uruguay and the Chilian minister of foreign relations have signed this document in duplicate copy, and affixed thereto their respective seals.

[L. S.] J. ARRIETA,
[L. S.] ADOLFO IBAÑEZ.

From the Smithsonian Institution, January 31, 1885, *to Hon. F. T. Frelinghuysen, Secretary of State.*

SIR: In acknowledging the receipt of your letter of the 30th of December last, inclosing a copy of a note from the Chargé d'affaires of Uruguay in reference to an exchange of publications between that Government and the Government of the United States, I beg to say that an answer was necessarily deferred until a translation could be made of the Spanish document accompanying your communication, the original of which is herewith returned.

It is not my province to offer suggestions to the Government of Uruguay regarding a general system of exchanges with the various Governments of the world; but so far as the United States is concerned, I can say that it will give the Smithsonian Institution much pleasure to make the necessary arrangements for an interchange of official publications of the two countries, the Institution sending to Uruguay at least once a year, and perhaps twice, all the publications of the Government of the United States, whether printed by order of Congress or any of the Departments—these, of course, in return for an equally exhaustive and comprehensive transmission on the part of the Government of Uruguay, all the returns received to be placed in the Library of Congress.

The Smithsonian Institution cannot undertake to secure publications generally of the scientific and literary establishments of the United States, but it will be happy to do all in its power in this respect. It is, however, willing to send its own works—the Smithsonian Contributions to Knowledge, the Miscellaneous Collections, and the Annual

Reports, which embody a large percentage of American scientific literature.

In return for this special and separate sending it would expect for its own library copies of any works on scientific subjects published by the Government of Uruguay.

In reference to the best, or most convenient, method of conducting an exchange of publications between the two countries in question, I beg to say that where distant communication by sea is involved, as is the case in the present instance, we find it most convenient to deliver all packages, free of freight, to the consul in New York of the country addressed, and to have the returns transmitted free of cost to the American consul at the port of shipment.

This course is pursued for the reason that any question of ocean expenses can be more readily settled on delivery of the packages. Although differing somewhat from that agreed upon at Brussels, this arrangement has been acceded to by all the European correspondents of the Smithsonian Institution. Of course it would not be impossible to make deliveries at Montevideo, if that be the proper port of entry, but there would necessarily be petty charges that even in that case it would be difficult to arrange for.

I inclose for the information of the chargé d'affaires of Uruguay some of the publications of the Smithsonian Institution bearing upon the subject of exchanges, and which possibly may contain some information that will interest him.

A first transmission can be made by our sending as complete a series of the documents of the United States Government as can now be supplied. This will consist of publications for a number of years, and will include several hundred volumes, occupying 13 cases. And we shall be pleased to receive information as to the exact address for the consignment, both in this country and Uruguay.

I have the honor to be, very respectfully, your obedient servant,

SPENCER F. BAIRD.

EXCHANGES WITH AUSTRIA.

From the Department of State, Washington, D. C., February 11, 1885, *to Prof. Spencer F. Baird, Secretary Smithsonian Institution.*

SIR: As suggested by dispatch No. 50 of the 21st ultimo, from Vienna, I inclose a copy of the same and of the list of official works of the Austro-Hungarian Government for exchange, to which it refers; and I also inclose, for the better understanding of dispatch No. 50, copies of two previous dispatches on the exchange of Government publications with Austria-Hungary.

I am, &c.,

FRED. T. FRELINGHUYSEN.

[Inclosed.]

Mr. Francis to Mr. Frelinghuysen January 21, 1885, No. 50.
Mr. Francis to Mr. Frelinghuysen, October 16, 1884, No. 17.
Mr. Francis to Mr. Frelinghuysen, October 24, 1884, No. 20.

From Hon. John M. Francis, ambassador, United States legation, Vienna, October 16, 1884, *to Hon. Frederick T. Frelinghuysen, Secretary of State, Washington, D. C.*

SIR: I have the honor to report that Mr. George H. Boehmer, chief of Exchange Bureau for the Smithsonian Institution and the Congressional Library, having special reference to Government publications, recently visited Vienna with a view of securing such exchange between Austria-Hungary, and the Bureau above named, of which he is chief.

In conformity with your general instruction to diplomatic agents of the United States abroad, of which Mr. Boehmer was the bearer, I assisted him in procuring interviews with representatives of the Austro-Hungarian Government, who are authorized to treat upon the object of his mission, for this purpose securing audience on the 9th instant with Count Szögyényi, chief of section of Ministry of Foreign Affairs, on which occasion the subject-matter was fully discussed, and the methods to be adopted in the proposed exchange freely canvassed.

Count Szögyényi expressed much interest in the matter, and appointed a meeting for the next day with Mr. Boehmer, to give it further consideration. Mr. Boehmer was subsequently placed in communication with other departments of the Government to arrange details, and the result as reported to me by him was in every respect satisfactory. The publications will now be sent forward regularly from each capital, the one to the other, in the exchange of Government publications.

The details of the agreement entered into will be reported by Mr. Boehmer to the Congressional Librarian.

From Hon. John M. Francis, ambassador, United States legation, Vienna, October 24, 1884, *to Hon. Frederick T. Frelinghuysen, Secretary of State, Washington, D. C.*

SIR: Referring to my No. 17, of the date of October 16th, relative to the exchange of Government publications between the Government of the United States and that of Austria-Hungary, I have the honor to inclose herewith copy of note on this subject to Count Szögyényi, chief of section of Ministry of Foreign Affairs, of the date of October 9, with copy of inclosure therein, a letter of same date addressed to me by Mr. George H. Boehmer, chief of Exchange Bureau of the Smithsonian Institution, and delegate of the Library of Congress of the United States. I also inclose translation of a communication from Count Szögyényi, dated October 20, in reply to my note as above, showing the progress thus far made in the matter.

From Hon. John M. Francis, ambassador, United States legation, Vienna, October 9, 1884, *to his excellency the Count Szögyényi, chief of section of Ministry of Foreign Affairs.*

YOUR EXCELLENCY: I have the honor to inclose herewith a copy of a communication this day received by me from Mr. George H. Boehmer, delegate of the Library of Congress of the United States, treating of the subject of a proposed exchange of official documents between the Government of the United States and Austria-Hungary.

I beg leave to inform your excellency that I have received instructions from my Government to aid as far as may be convenient in drawing the attention of His Imperial Majesty's Government to the subject matter referred to, with the hope that the exchange of Government publications as proposed may be favorably regarded by His Majesty's Government to the end that the desired object be assured.

I avail myself of this occasion to renew to your excellency the assurance of my distinguished consideration.

From George H. Boehmer, Vienna, Austria, October 9, 1884, *to his excellency Mr. John M. Francis, envoy extraordinary and minister plenipotentiary of the United States of America, Vienna.*

SIR: In the year 1867, the Congress of the United States passed a law authorizing the exchange, under the direction of the Smithsonian Institution, of a certain number of all the United States official documents for the corresponding publications of other Governments throughout the world, the returns to be placed in the National (Congressional) Library.

The object of this law was to procure for the use of the Congress of the United States a complete series of the publications of other Governments.

A circular letter was therefore issued by the Smithsonian Institution, asking the advice of the various Governments as to the best method of accomplishing the object.

It was important to ascertain what Governments were willing to enter into the proposed exchange, and whether any one person or branch of the Government or public library in each country would undertake to collect all the national publications and transmit them to Washington. Information was also desired as to the titles and character of the regular official publications of each country, and their average number and extent in each year, as well as the names of the different sources from which they emanate.

On the 30th of October, 1875, a circular was sent by Professor Henry, Secretary of the Smithsonian Institution, with a letter to the foreign ministers at Washington,* and among them to the ambassador of His Majesty the Emperor of Austria.

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* [This circular and letter were published in the Smithsonian Report for 1881, pp. 768, 769.]

In accordance with instructions received in respect to the letter referred to, the first two boxes of documents were sent to Vienna, and are now deposited in the Imperial Royal Library. Subsequent transmissions, however, were refused by the imperial legation at Washington as being too bulky.

It is now desired by the Congress of the United States of America to resume relations of exchanges with the Empire of Austria, this being the only Government required to complete the exchange service with the United States of all the European monarchies, and in this connection I beg to remark that the Smithsonian Institution, as the authorized agent of the Government, has now ready for transmission, (in addition to the boxes of documents already received into the Imperial Royal Library), eighteen (18) boxes, each of about six cubic feet, containing several thousand volumes, and to which about two boxes will be added each year. This entire accumulation would, upon acceptance of the terms and conditions of the exchange on the part of His Imperial Majesty's Government, be delivered at once and free of cost to any agent the Imperial Government might be pleased to appoint at any seaport of the United States, while the returns on the part of His Imperial Majesty's Government should be placed, free of cost, in the hands of Dr. Felix Flügel, 49 Sidonien Strasse, Leipsic, the agent of the Smithsonian Institution for Europe. The boxes or parcels thus sent should be marked, "To the Smithsonian Institution, for the Library of Congress," and both these establishments be informed of the sending by letter, together with a list of the documents sent.

In obedience to instructions I have the honor to submit this proposal of exchange to you, and to request your excellency to lay the same before the proper authorities of His Imperial Majesty's Government and to kindly advise me of any action taken or any results derived from this application.

From his excellency the Count Szögyényi, chief of section of Ministry of Foreign Affairs, to Hon. John M. Francis, ambassador, Vienna, October 20, 1884.

SIR: In conformity with the desire expressed in the esteemed note of the 9th instant, F. O. No. 8, the Ministry of Foreign Affairs has made known to the respective imperial and royal central stations the mission of Mr. Boehmer, chief of Congressional Bureau of the United States for International Exchange, who proposed making an agreement whereby a regular exchange of official publications may be established between the Governments of Austria-Hungary and the United States.

The Imperial Royal Ministry of the Interior has already expressed its approval of such an agreement as far as its department is concerned, and observes in this connection that it deems it most advisable to confine itself to the regular communication of the reports of the sessions of the Austrian Parliament and of the official paper known as the Legal

Advertiser (Reichs Gesetzblatt), which publishes all the general laws enacted, believing that reports of the sessions of the several provincial diets and the different provincial laws and regulations would be of but a secondary interest to the United States Government.

The undersigned will not fail to communicate to the Hon. J. M. Francis, envoy extraordinary and minister plenipotentiary of the United States of America, all further information bearing upon this question, and avails himself of this opportunity to tender a renewed assurance of his high esteem.

From Hon. John M. Francis, ambassador, United States legation, Vienna, January 21, 1885, *to Hon. Frederick T. Frelinghuysen, Secretary of State, Washington, D. C.*

SIR: I have the honor to inclose herewith translation of a note from Baron Pasetti, chief of section Ministry of Foreign Affairs, dated January 16, 1885, in regard to the exchange of Government publications between the Government of the United States and that of Austria, as fully set forth in my No. 20 of October 24, 1884.

Baron Pasetti's note, with accompanying inclosure of a list of official works from the imperial royal department of public instruction, explains or suggests the basis of the proposed international exchange, which has the approval of Mr. Boehmer, agent for the Congressional Library and Smithsonian Institution, who recently conferred with the proper Government officials here on this subject.

Mr. Boehmer now requests that a copy of the inclosed communication from Baron Pasetti and the accompanying list of official works referred to be transmitted by the department to the directors of the Smithsonian Institution.

From Baron Pasetti, minister of foreign affairs, Vienna, January 16, 1885, *to Hon. John M. Francis envoy extraordinary and minister plenipotentiary of the United States.*

SIR: On the 20th of October last, under Nos. $\frac{6192}{9}$, the Ministry of Foreign Affairs had the honor of informing Hon. John M. Francis, envoy extraordinary and minister plenipotentiary of the United States of America, that the Imperial Royal Ministry of the Interior had consented to an establishment of a regular exchange of official publications with the United States Government.

In the mean time a note has been received by the Ministry of Foreign Affairs from the Imperial Royal Ministry of Instruction, wherein the latter makes known its views on the above question.

The last named ministry says that the exchange of official publications and of periodicals published by scientific institutes in Austria has been uniformly pursued for some time. Numerous copies are forwarded annually in every direction, and the volumes sent in return by institutes abroad are promptly and regularly received. This direct mode of exchange between the respective corporations, institutes, &c., facilitates not only the requirements in the most speedy and simple manner, but tends also to reduce the expenses of transmission to the lowest possible rate. The Imperial Royal Ministryof Instruction would nevertheless be ready to accept the proposal made by the American Government as far as its department is concerned on condition that the exchange be not extended to all publications made, but be confined to such as would upon investigation be found to be the most acceptable and needed by both parties, and that the number of copies to be sent would also be made dependent upon this rule. With this view the Ministry of Foreign Affairs begs to inclose herewith to the North American envoy a list compiled by the Ministry of Instruction, giving the publications periodically appearing under its direction, and requests that it be transmitted, and that the number and the titles of the copies desired on the part of America be pointed out.

The Ministry of Foreign Affairs addresses itself at the same time to the other departments interested in the exchange in question, requesting them to make known their views on the subject, and to send in similar lists of periodicals published under their direction.

As far as the publications are concerned which have been offered by America, the Ministry of Foreign Affairs will first inform the different departments of the receipt of the work published by Mr. Boehmer, entitled "History of the Smithsonian Exchanges," of which the author had the kindness of placing several copies at the disposal of the Imperial Royal Government, in connection with which it must be observed that the list of official American publications the work contains only reaches as far back as the year 1881, which will probably make a supplement necessary.

The Ministry of Foreign Affairs begs to observe here that the Ministry of Instruction regards it as a matter of course that this proposed new arrangement will in no way affect or alter the exchange of publications kept up for a number of years heretofore with the Smithsonian Institution.

Finally, the ministry wishes to say that in case an agreement is made the publications intended for Austria be forwarded by the American Government to Vienna, carriage paid, and that the Austrian consignments be sent, carriage paid, to be delivered either at Leipsic or at Washington, according to the desire of the American Government.

While the Ministry of Foreign Affairs has the honor of conveying this intelligence to the knowledge of the honorable North American envoy, the undersigned embraces the opportunity to renew the assurance of his profound consideration.

List of official works published periodically under the direction of the Ministry of Worship and Public Instruction.

(1) Record of laws issued by the Ministry of Instruction.

(2) Report of the sessions of the Imperial Academy of Science at Vienna, viz:
  (*a*) Philosophic historical class.
  (*b*) Mathematic natural-science class.

(3) Memorial of the Imperial Academy of Science at Vienna, viz:
  (*a*) Philosophic historical class.
  (*b*) Mathematic natural-science class.

(4) Almanac of the Imperial Academy of Science at Vienna.

(5) Austrian Statistics, published by the Statistical Central Commission.

(6) Year Book of the Imperial Royal Institute for Meteorology and Magnetism.

(7) Annals of the Imperial Observatory at Vienna.

(8) Astronomical Calendar, published by the Imperial Observatory at Vienna.

(9) Year Book of the Geological Institute.

(10) Results of investigations made by the Geological Institute.

(11) Treatises of the Imperial Geological Institute at Vienna.

(12) Austrian historical sources.

(13) Archives for Austrian history, published by the Imperial Academy of Science at Vienna.

(14) Communications made by the Imperial Institute for Historical Researches.

(15) Communications of the Imperial Royal Central Commission for Preservation of Historical Monuments.

(16) Communications made by the Imperial Royal Museum for Art and Industry.

(17) Central organ for industrial schools in Austria, published under the direction of the Ministry of Instruction, together with a supplement.

STATISTICS OF EXCHANGES FOR THE SIX MONTHS ENDED JUNE 30, 1885.

I.—RECEIPTS.

1. *For foreign distribution.*

Whence received.	Packages.	Weight.
(*a*) From Government Departments:	*Number.*	*Pounds.*
Bureau of Ethnology	3	21
Bureau of Navigation	1	18
Coast and Geodetic Survey Office	1	16
Department of Interior	935	6,812
Department of Justice	50	24
Department of State	28	26
Engineer Bureau, U. S. A	5	61

1. *For foreign distribution*—Continued.

Whence received.	Packages.	Weight.
(*a*) From Government Departments—Continued.		
Fish Commission	144	486
Geological Survey Office	3,125	21,792
House of Representatives	1	11
Library of Congress	1,007	4,728
National Museum	157	806
Nautical Almanac Office	16	69
Naval Observatory	6	38
Patent Office	14	3,776
Senate	11	26
Signal Office	868	4,456
Surgeon-General's Office	3	35
Treasury Department	20	42
War Department	4	67
Total	6,399	43,310
(*b*) From the Smithsonian Institution	886	2,980
(*c*) From scientific societies	3,143	12,434
(*d*) From individuals	260	1,751
Total	10,688	60,475

2. *For domestic distribution.*

From—	Boxes.	Parcels.	Weight.
	Number.	*Number.*	*Pounds.*
Argentine Republic	1	57	250
Belgium	3	233	510
Denmark	1	37	43
France	8	592	2,790
Germany	20	1,703	5,850
Great Britain and Ireland	31	792	4,003
Netherlands	1	85	210
Norway	2	49	257
New South Wales	2	26	47
Russia	2	105	415
Total	71	3,679	14,375

3. *For Government exchanges.*

For what and whence received.	Boxes.	Packages.	Weight.
(*a*) For Library of Congress, from—	*Number.*	*Number.*	*Pounds.*
Hungary	1	3	257
France	16	16	4,330
England	13	13	2,545
Netherlands	1	1	300
(*b*) For foreign Governments, from—			
Public Printer	....	29,200	14,750
Total	31	29,233	22,182

RECAPITULATION.

For what and whence received.	Packages.	Weight.
	Number.	*Pounds.*
1. For foreign distribution	10,688	60,475
2. For domestic distribution	3,679	14,375
3. For Government exchanges	29,233	22,182
Total	43,600	97,032

II.—TRANSMISSIONS.

1. *Foreign transmissions.*

Country.	Boxes.	Total.
Africa:		
Algeria	2	
Cape Colony	1	
Egypt	1	
		4
America:		
Canada	4	
New Brunswick	2	
Newfoundland	1	
Mexico	5	
Guatemala	1	
San Salvador	1	
Cuba	2	
Hayti	1	
Jamaica	1	
Trinidad	2	
Argentine Confederation	3	
Brazil	3	
Chili	1	
Peru	2	
		29
Asia:		
Philippine Islands	1	
		1
Australasia:		
New South Wales	3	
New Zealand	3	
South Australia	1	
Victoria	3	
		10
Europe:		
Austria Hungary*	......	
Bavaria*	......	
Belgium	11	
Denmark	5	
France	41	
Germany	92	
Great Britain	78	
Greece	2	
Italy	22	
Netherlands	7	
Norway	5	
Portugal	3	
Prussia*	......	
Russia	13	
Saxony*	......	

* Included in Germany.

1. *Foreign transmissions*—Continued.

Country.	Boxes.	Total.
Europe:		
Spain	3	
Sweden	7	
Switzerland	9	
Turkey	3	
Wurtemberg*	....	301
Total	....	345

* Included in Germany.

RECAPITULATION.

Countries.	Boxes.
Africa	4
America	29
Asia	1
Australasia	10
Europe	301
Total	345

Transportation Companies.—As in former years the privilege of free freight has been continued on the part of most of the steamship lines to Europe.

2. *Domestic transmissions.*

Five thousand one hundred and nineteen packages were received during the first six months of 1885, against 10,236 during the 12 months of 1884, and distributed within the United States as follows:

State.	No. of packages.	State.	No. of packages.
Alabama	6	Missouri	141
Arkansas	4	Nebraska	1
California	85	New Hampshire	8
Colorado	6	New Jersey	31
Connecticut	103	New York	611
Delaware	2	North Carolina	1
District of Columbia	2,097	Ohio	82
Florida	1	Oregon	1
Georgia	2	Pennsylvania	420
Illinois	85	Rhode Island	31
Indiana	21	South Carolina	13
Iowa	106	Tennessee	1
Kansas	10	Texas	3
Kentucky	7	Vermont	8
Louisiana	89	Virginia	11
Maine	13	Washington Territory	2
Maryland	128	Wisconsin	122
Massachusetts	762	Wyoming Territory	2
Michigan	28		
Minnesota	15	Total	5,119

The additions to the library of the Smithsonian Institution from exchanges, are:

Description.	Number.	Total.
Volumes:		
Octavo or smaller	688	
Quarto or larger	222	
		910
Parts of volumes:		
Octavo or smaller	1,971	
Quarto or larger	2,238	
		4,209
Pamphlets:		
Octavo or smaller	4,612	
Quarto or larger	256	
		4,868
Maps and charts		354
Total		10,341

3. *Government transmissions.*

The twenty-third box of the series of Government publications to be exchanged under the Congressional acts of March 2, 1867, and July 25, 1868, was transmitted on the 23d of April for deposit in the establishments designated by the respective Governments for the reception of Government exchanges.

LIST OF FOREIGN CORRESPONDENTS.

By GEORGE H. BOEHMER.

One of the instructions furnished on occasion of an official visit to Europe, in July, 1884, on business connected with the exchange of official public documents of the United States with foreign Governments, provided for the collecting of accurate and sufficient data to be employed in correcting the "List of Foreign Correspondents of the Smithsonian Institution" in use by the exchange service of that establishment; and, as a result of the attention given by the compiler to the instructions received, a new list, corrected and revised to the 1st of July, 1885, is herewith presented.

The present list has been made as perfect and correct as has been possible with the assistance of the agents of exchange in the various countries visited. Among the gentlemen who have extended aid and facilities for the proper execution of the work, and to whom the warmest thanks of the compiler are due, the following names deserve special mention:

M. Alvin, Secretary of the Belgian Commission of International Exchanges, Brussels, Belgium.

M. Angeli, Sous-Chef, Italian Commission of International Exchanges, Rome, Italy.

M. Ahlstrand, Librarian, Kongelige Svenska Vetenskaps Akademien, Stockholm, Sweden.

Professor von Baumhauer, Harlem, Netherlands.

M. Bruun, Principal Librarian, Royal Library, Copenhagen, Denmark.

M. Boye-Ström, Director, Royal Statistical Bureau, Christiania, Norway.

Dr. Bodio, Director, Royal Statistical Bureau, Rome, Italy.

Herr Axel Charlot Drolsum, Principal Librarian, Kongelige Norske Frederiks Universitet, Christiania, Norway.

Dr. Foerstemann, Principal Librarian, Royal Public Library, Dresden, Saxony.

Dr. von Gerber, Royal Saxon Minister of State, Dresden, Saxony.

Professor Dr. Hartmann, Director, Royal Wurtemberg Statistical Topographical Bureau, Stuttgart, Wurtemberg.

Dr. G. Hellmann, Director, Royal Prussian Meteorological Bureau, Berlin, Germany.

Dr. Heyd, Principal Librarian, Royal Library, Stuttgart, Wurtemberg.

M. G. E. Klemming, Principal Librarian, Royal Library, Stockholm, Sweden.

Dr. Laubmann, Principal Librarian, Royal Library, Munich, Bavaria.

M. Passier, Sous-Chef, French Bureau of International Exchanges, Paris, France.

M. de Plason, Councillor, Imperial Royal Ministry of Foreign Affairs, Vienna, Austria.

Dr. Potthast, Principal Librarian, Library of the German Parliament, Berlin, Germany.

M. Richter, Librarian, Royal Public Library, Dresden, Saxony.

M. Rigier, Chancellor of the Swiss Republic, Bern, Switzerland.

M. Sidenblah, Director, Statistical Central Bureau, Stockholm, Sweden.

M. de Stuers, Councillor, Interior Department The Hague, Netherlands.

Dr. Volger, Frankfort-on-the-Main, Germany.

William Wesley, Esq., Smithsonian Exchange Agent, London, England.

Dr. E. Blenck, Director, Royal Prussian Statistical Bureau, Berlin, Germany.

A liberal use has also been made of the information contained in the following publications:

Allgemeines deutsches Vereins-Handbuch. Statistisches Repertorium der gelehrten Gesellschaften und wissenschaftlich gemeinnützigen Vereine der Staaten des dermaligen deutschen Reiches, von Hans Adam Stoehr, G. I. F. D. H.

Annuaire publié par le Bureau des Longitudes, Paris, France.

Annuals and State calendars of all the cantons of Switzerland.

Årskatalog för Svenska Bokhandeln, 1866–1883.

Calendario General del Regno d' Italia, pel 1884.

Bibliographie de Belgique, 1875–1884.

Daheim Kalender, 1884.

Das Unterrichtswesen in Ungarn, 1884.

Gotha Almanac, 1884.

Hatch's Tasmanian Almanac, 1884.

Hof- und Staats-Handbuch der österreichisch-ungarischen Monarchie, 1884.

Müller, Dr. Johannes, Die wissenschaftlischen Vereine und Gesellschaften Deutschland's in 19. Jahrhundert, 1884.

Katalog der Bibliothek des deutschen Reichstags.

Nieder-österreichischer Amts-Kalender, Wien, 1884.

Pugh's Queensland Almanac, 1884, 1885.

Sveriges Staats-Kalender, 1884.

[The figure [i] at the end of the title indicates recipients of the *Smithsonian Report;* [ii], those who receive the *Report* and the *Miscellaneous Collections;* [iii], those who receive the two preceding and the *Smithsonian Contributions to Knowledge.*]

AFRICA.

ALGERIA.

Algiers.

1. "Alger Médical" (*Algiers Medical*). [i]
3. Bibliothèque de la Ville (*City Library*). [i]
5. École de Médecine et de Pharmacie d'Alger (*School of Medicine and Pharmacy of Algiers*). [i]
7. École Supérieure des Sciences:—Laboratoire de Physiologie (*High School of Sciences—Physiological Laboratory*).
9. Journal de Médecine et de Pharmacie de l'Algérie (*Medical and Pharmaceutical Journal of Algeria*). [i]
11. Observatoire National (*National Observatory*). [i]
13. Société d'Agriculture d'Alger (*Algiers Agricultural Society*). [i]
15. Société Algérienne de Climatologie, Sciences Physiques et Naturelles (*Algerian Society of Climatology, Physical and Natural Sciences*). [i]
17. Société Historique Algérienne (*Algerian Historical Society*). [i]

Bône.

19. Académie d'Hippone—Société de Récherche Scientifique et d'Acclimatation (*Veterinary Academy—Society for Scientific Research and Acclimation*). [i]

Constantine.

21. Société Archéologique de la Province de Constantine (*Archæological Society of the Province of Constantine*). [i]

Oran.

23. Société de Géographie d'Oran (*Geographical Society of Oran*). [To be addressed to care of M. Julian Poinssot, 15 Rue Royer-Colland, Paris, France.]

AZORES.

Ile Terceira.

25. Observatoire Météorologique (*Meteorological Observatory*). [i]

CAPE COLONY.

Cape Town (*Cape of Good Hope*).

27. Agricultural Society. [i]
29. Folklore Journal.
31. Geological Survey of the Colony.

Cape Town (*Cape of Good Hope*).—Continued.

33. Meteorological Commission.
35. Royal Observatory. [iii]
37. Sir George Gray's Library.
39. South African Museum. [i]
41. South African Philosophical Society. [i]
43. South Africa Public Library. [iii]

Somerset East.

45. Gill College. [i]

EGYPT.

Alexandria.

47. Ministère de l'Intérieur (*Interior Department*).

Cairo.

49. The Khédive of Egypt. [i]
51. Bibliothèque Centrale (*Central Library*). [i]
    [Bureau de Statistique—ceased to exist, but the former director requests continuation of publications.]
53. Institut Égyptien (*Institute of Egypt*). [iii]
55. Musée de Boulaq (*Boulaq Museum*). [i]
57. Observatoire Khédivial (*Khédival Observatory*). [i]
59. Société Égyptienne (*Egyptian Society*). [i]
61. Société Khédiviale de Géographie (*Khédival Géographical Society*). [i]

GUINEA.

Lagos.

63. Wesleyan College.

LIBERIA.

Monrovia.

65. Government Library. [iii]
67. Liberia College. [iii]

MADEIRA.

Funchal.

69. Observatoire Météorologique (*Meteorological Observatory*). [i]

MALTA.

Malta.

71. Public Library. [i]

MAURITIUS.

Pamplemouses.

73. Meteorological and Magnetical Observatory. [i]

Port Louis.

75. Library of Port Louis. [i]
77. Meteorological Society of Mauritius. [i]
79. Royal Society of Arts and Sciences. [i]
81. Société d'Acclimatation (*Acclimation Society*). [i]
83. Société d'Histoire Naturelle (*Natural History Society*).

MOZAMBIQUE.

Mozambique.

85. Sociedad de Geografia (*Geographical Society*). [i]

ST. HELENA.

St. Helena.

87. Magnetic and Meteorological Observatory. [i]
89. St. Helena Library. [i]

AMERICA (NORTH).

BRITISH AMERICA.

CANADA.

Belleville (*Ontario*).
91. Murchison Scientific Society.
93. Ontario Institute for the Deaf, Dumb, and Blind.

Cape Rouge (*Quebec*).
95. Le Naturaliste Canadien (*Canadian Naturalist*). [i]

Charlottetown (*Prince Edward Island*).
97. Legislative Library.

Clifton (*Ontario*).
99. Victoria University.

Guelph (*Ontario*).
101. Ontario School of Agriculture. [i]

Hamilton (*Ontario*).
103. Hamilton Association.

Kingston (*Ontario*).
105. Botanical Society of Canada.
107. Queen's University.

London (*Ontario*).
109. Canadian Entomologist. [i]
111. Entomological Society [formerly in Toronto]. [i]

Montreal (*Quebec*).
113. Canadian Antiquarian and Numismatic Chronicle.
115. Canadian Naturalist and Geologist.
117. Department of Public Instruction. [i]
119. Ecole Normale Jacques Cartier (*Jacques Cartier Normal School*). [i]
121. Journal de l'Instruction Publique (*Journal of Public Instruction*).
123. Legislative Library of the Province of Quebec. [i]
125. McGill University. [iii]
127. Natural History Society. [i]
129. Numismatic and Antiquarian Society. [i]
131. Royal Society of Canada.

Montreal (*Quebec*)—Continued.

133. Société Historique de Montreal (*Historical Society of Montreal*). [i]
135. St. Laurent College.

Ottawa (*Ontario*).

137. Academy of Natural Sciences.
139. Department of Agriculture. [i]
141. Field Naturalists' Club.
143. Geological and Natural History Survey of Canada. [iii]
145. Library of Parliament. [iii]
147. Literary and Scientific Society. [i]
149. Young Men's Christian Association.

Port Hope (*Ontario*).

151. Trinity College School. [i]

Quebec (*Quebec*).

153. Department of Agriculture.
155. Geographical Society of Quebec. [i]
157. Literary and Historical Society of Quebec. [i]
159. Parliamentary Library.
161. Université Laval (*Laval University*). [iii]

St. Catherine (*Ontario*).

163. Fruit Growers' and Forestry Association [formerly in Toronto]. [i]

Toronto (*Ontario*).

165. Canadian Institute. [iii]
167. Canadian Journal of Science, Literature, and History.
169. Department of Education.
171. Government of Canada. [i]
173. Legislative Library.
175. Magnetic Observatory. [i]
177. Meteorological Office of the Dominion of Canada. [i]
179. Natural History Society of Toronto.
181. Public Library.
183. School of Practical Science.
185. The Canadian Educational Monthly Publishing Company.
187. Toronto Globe.
189. Trinity College.
191. University College. [iii]

MANITOBA.

Fort Garry.

193. Institute of Prince Rupert's Land.

Winnipeg.

195. Department of Agriculture, Statistics, and Health.
197. Legislative Library.
199. Manitoba Historical and Scientific Society. [iii]
201. St. John's College.

NEW BRUNSWICK.

Fredericton.

203. Legislative Library.
205. Mechanics' Institute.
207. Office of Agriculture of the Province of New Brunswick.
209. University of New Brunswick. [iii]

St. John's.

211. Natural History Society. [i]
213. Observatory.
215. Public Library.

NEWFOUNDLAND.

St. John's.

217. Geological Survey of Newfoundland. [i]
219. Legislative Library.
221. "North Star."

NOVA SCOTIA.

Halifax.

223. Botanical Society of Canada.
225. Dalhousie College. [i]
227. Department of Mines. [i]
229. Legislative Library.
231. Nova Scotia Historical Society. [i]
233. Nova Scotia Institute of Natural Sciences. [i]
235. Nova Scotia Medical Society. [i]
237. University of Halifax.

Pictou.

239. Pictou Academy.

Windsor.

241. University of King's College.

Wolfville.

243. Acadia College.
245. Acadian Science Club.

CENTRAL AMERICA.

COSTA RICA.

San José.

247. Central Office of Statistics and Meteorology.
249. University of Costa Rica. [iii]

GUATEMALA.

Guatemala.

251. Instituto Nacional de Guatemala (*National Institute of Guatamala*). [iii]
253. Meteorological Observatory.
255. Secretaria de Fomento (*Department of Interior*).

NICARAGUA.

Grenada.

257. Grenada College.

SAN SALVADOR.

San Salvador.

259. Museo Nacional (*National Museum*).

MEXICO.

Chapultepec (*Tacubaya*).

261. Observatorio Astronomico Nacional (*National Astronomical Observatory*). [i]

Guadalajara (*Jalisco*).

263. Société des Ingénieurs de Jalisco (*Engineers' Society of Jalisco*).
265. Sociedad Médica de Guadalajara (*Medical Society of Guadalajara*). [i]

Guanajuato (*Guanajuato*).

267. Colegio del Estado (*State College*). [i]
269. Observatorio Meteorologico del Colegio del Estado (*Meteorological Observatory of the State College*).

Mérida (*Yucatan*).

271. Sociedad Médica Farmaceutica (*Medico-Pharmaceutical Society*). [i]
273. Yucate Register (*Yucatan Register*).

Mexico.

275. Academia de Medicina (*Academy of Medicine*). [i]
277. Asociacion Médico Quirurgica "Larrey" (*"Larrey" Medico-Chirurgical Society*). [i]
279. Biblioteca Nacional (*National Library*).
281. City Council.
283. Direction Général de la Statistique (*Bureau of Statistics*).
285. El Museo Nacional (*National Museum*). [i]
287. Escuela de Agricultura (*Agricultural School*). [i]
289. Escuela de Medicina (*Medical School*). [i]
291. Escuela Nacional de Ingeneiros (*National School of Engineers*). [iii]
293. Escuela Nacional Preparatoria (*National Preparatory School*). [i]

Mexico—Continued.

295. Mexican Government. [i]
297. Ministerio de Fomento, Colonizacion, Industria y Comercio (*Department of Interior, Colonization, Industry, and Commerce*). [i]
299. Ministerio de Justicia y Instruccion Publica (*Department of Justice and Public Instruction*).
301. Ministerio de Trabajo Publica (*Department of Public Works*).
303. Observatorio Meteorologico Central (*Central Meteorological Observatory*). [i]
305. Revista Cientifica Mexicana (*Mexican Scientific Review*).
307. Sociedad "Andres del Rio" (*Society "Andres del Rio"*). [i]
309. Sociedad Cientifica "Antonio Alzate" (*Scientific Society "Antonio Alzate"*).
311. Sociedad Filoiatrica y de Beneficencia de los Alumnos de la Escuela de Medicina (*Alumni Beneficial Society of the Medical College*). [i]
313. Sociedad Humboldt (*Humboldt Society*). [i]
315. Sociedad Médica (*Medical Society*). [i]
317. Sociedad Mexicana de Geografia y Estadistica (*Mexican Geographical and Statistical Society*). [iii]
319. Sociedad Mexicana de Historia Natural (*Mexican Natural History Society*). [iii]
321. Sociedad Minera Mexicana (*Mexican Mineralogical Society*). [i]
323. University of Mexico.

Puebla (*Puebla*).

325. Observatorio Meteorologico del Colegio Catolico (*Meteorological Observatory of the Catholic College*).

San Luis Potosi (*San Luis Potosi*).

327. Instituto Cientifica y Literaria (*Scientific and Literary Institute*). [i]
329. Sociedad Mědica (*Medical Society*). [i]

Toluca.

331. Instituto Literario del Estado de Mexico (*Literary Institute of the State of Mexico*). [i]

WEST INDIES.

BAHAMAS.

New Providence.

333. Nassau Public Library. [i]

BARBADOES.

Bridgetown.

335. Government Meteorological Office. [i]

BERMUDAS.

Hamilton.

337. Bermuda Library. [i]

CUBA.

Habana (*Havana*).

339. Academia de Ciencias Médicas, Fisicas, y Naturales de la Habana (*Academy of Medical, Physical, and Natural Sciences of Havana*). [i]
341. Administracion General de Correos de la Isla de Cuba (*Post-Office Department of the Island of Cuba*).
343. Inspeccion General de Telegrafos (*Inspector-General of Telegraphs*). [i]
345. Instituto de Segenada Enseñanza de la Habana (*Institute for Preliminary Education in Sciences and Letters*).
347. Observatorio Magnético y Meteorologico del Real Colegio de Belen (*Magnetic and Meteorological Observatory of the Royal College of Belen*). [i]
349. Real Observatorio Fisico-Meteorologico de la Habana (*Royal Physico-Meteorological Observatory of Havana*). [i]
351. Real Sociedad Económica de la Habana (*Royal Economic Society of Havana*). [iii]
353. Real Universidad de la Habana (*Royal University of Havana*). [i]
355. Revista General de Comunicaciones (*General Review of Communications*).
357. Sociedad Antropologica (*Anthropological Society*). [i]

GUADELOUPE.

Point-à-Pitre.

359. Musée l'Herminier (*Herminier Museum*). [i]

JAMAICA.

Kingston.

361. Public Museum.
363. Royal Society of Arts of Jamaica. [iii]

TRINIDAD.

Port of Spain.

365. Scientific Society of Trinidad. [i]

TURK'S ISLANDS.

Grand Turk.

367. Public Library of Turk's and Caicos Islands. [i]

AMERICA (SOUTH).

ARGENTINE REPUBLIC.

Buenos Aires.

369. Asociacion Médica Bonaereuse (*Buenos Aires Medical Society*). [i]
371. Biblioteca Nacional (*National Library*). [i]
373. Biblioteca Pública (*Public Library*). [i]
375. Instituto Geográfico Argentino (*Argentine Geographical Institute*). [i]
377. Instituto Historio-Geográfico del Rio de la Plata (*Historio-Geographical Institute of La Plata*).
379. Ministère de l'Intérieur (*Department of the Interior*).
381. Ministère des Affaires Etrangères (*Foreign Office*).
383. Municipal Authority.
385. Museo Público de Buenos Aires (*Public Museum of Buenos Aires*). [iii]
387. Oficina Nacional de Estadistica Comercial de la Republica Argentina (*National Bureau of Commercial Statistics of the Argentine Republic*).
389. Sociedad Cientifica Argentina (*Argentine Scientific Society*). [i]
391. Sociedad Entomológica Argentina (*Argentine Entomological Society*). [i]
393. Sociedad Paleontológica de Buenos Aires (*Paleontological Society of Bunso Aires*). [i]
395. Sociedad Rural Argentina (*Agricultural Society*). [i]
397. Sociedad Zoológica Argentina (*Zoological Society*). [i]
399. Statistical Bureau. [i]
401. Universidad de Buenos Aires (*University of Buenos Aires*) [Biblioteca Universitaria]. [i]

Cordoba.

403. Academia Nacional de Ciencias Exactes (*National Academy of Exact Sciences*). [i]
405. Observatorio Nacional Argentino (*Argentine National Observatory*). [i]
407. Oficina Meteorológica Argentina (*Argentine Meteorological Bureau*). [i]
409. Periodico Zoológico (*Zoologist*).

La Plata.

411. Oficina General de Estadistica de la Provincia de Buenos Aires (*General Statistical Bureau of the Province of Buenos Aires*).

BOLIVIA.

Chuquisaca.

413. University. [i]

BRAZIL.

Fortaleza (*Ceará*).

415. Library.

Rio Janeiro.

417. Emperor of Brazil. [iii]
419. Annals Brazil de Medicine (*Brazilian Annals of Medicine*).
421. "Auxiliador de Industria Nacional" (*Auxiliary of National Industry*). [i]
423. Biblioteca National (*National Library*). [ii]
425. British Library. [i]
427. Commissão Central Brazileiro de Permutacões Internacionães (*Central Brazilian Commission of International Exchanges*).
429. Conseil Municipal (*Municipal Council*).
431. Escola de Mines de Ouro Preto (*Mining Academy of Ouro Preto*).
433. Gazeta Médica (*Medical Gazette*).
435. Government of Brazil. [i]
437. Imperial Academy of Medicine.
439. Instituto Historico, Geografico y Ethnografico (*Historical, Geographical, and Ethnographical Institute*). [i]
441. Ministère des Travaux Publiques, du Commerce et de l'Agriculture (*Department of Public Works, Commerce, and Agriculture*).
443. Ministerio dos Negacios Estrangeiros (*Foreign Office*).
445. Museu Nacional (*National Museum*). [i]
447. Nautical Observatory. [i]
449. Palæstra Scientific Society. [i]
451. Royal Geographical Society. [i]
453. Seccion de la Sociedad Geografia de Lisbon (*Section of the Lisbon Geographical Society*).
455. Sociedad Geologica de Rio Janeiro (*Geological Society of Rio Janeiro*).
457. Statistical Bureau.

San Paulo.

459. Morton College.

BRITISH GUIANA.

Georgetown.

461. Geological Survey of British Guiana.
463. Observatory. [i]
465. Queen's College. [i]
467. Royal Agricultural and Commercial Society. [i]

CHILE.

Santiago.

469. Academia Militar (*Military Academy*). [i]
471. Biblioteca Nacional (*National Library*). [iii]
473. Bureau de Statistique (*Bureau of Statistics*). [i]
475. El Plano Topográfico (*Topographic Bureau*). [i]
477. Government of Chile. [i]
479. Meteorological Office.
481. Ministère de l'Intérieur (*Department of the Interior*).
483. Ministro de Instruccion Publico (*Department of Public Instruction*). [i]
485. Museo Nacional (*National Museum*).
487. Observatorio Nacional (*National Observatory*). [i]
489. Oficina Hidrográfica de Chile (*Hydrographic Office*). [i]
491. Sociedad de Historia Natural (*Natural History Society*). [i]
493. Sociedad Medica (*Medical Society*). [Calle de San Diego, No. 47.] [i]
495. Universidad de Chile (*University of Chile*). [iii]

Valparaiso.

497. Direction de la Statistique du Commerce (*Bureau of Commercial Statistics*).

COLOMBIA.

Bogota.

499. Central Commission of Exchange—National Library.
501. Government of Colombia. [i]
503. National Library. [iii]
505. Observatorio Astronomico Nacional (*National Astronomical Observatory*).
507. Observatorio Flammarion (*Flammarion Observatory*).
509. Secrétaire des Travaux Publiques et des Postes (*Department of Public Works and Post-Office Department*).
511. Sociedad de Estadistica y Geografia de Colombia (*Statistical and Geographical Society of Colombia*).
513. Sociedad de Medicina y Ciencias Naturales (*Society of Medicine and Natural Sciences*).
515. Sociedad de Naturalistas Colombianos (*Society of Colombian Naturalists*). [i]

Medellin.

517. Université d'Antioquia (*University of Antiochia*). [i]

Panama.

519. Administrador de la Aduana (*Customs Office*).
521. Gazetta Oficial de Panama (*Official Gazette of Panama.*)

DUTCH GUIANA.

Bahia.

523. Belgian Consulate. [i]

Paramaribo.

525. Surinaamsche Koloniaale Bibliotheek (*Surinam Colonial Library*). [i]

ECUADOR.

Quito.

527. Ministère des Finances et des Travaux Publiques (*Department of Finances and Public Works*).
529. Observatorio Astronomico del Colegio Nacional (*Astronomical Observatory of the National College*). [i]

PARAGUAY.

Asuncion.

531. Minister of Foreign Relations.
533. United States Consulate. [i]

PERU.

Lima.

535. Académia de Ciencias Naturales (*Academy of Natural Sciences*).
537. Cuerpo de Ingenieros del Péru (*Engineer Corps*). [i]
539. Escuela de Ingeniero (*Engineer School*).
541. Facultad de Medicina (*Medical Faculty*).
543. Minister of the Interior.
545. National Library. [iii]
547. Sociedad Geografica (*Geographical Society*).
549. Statistical Bureau. [i]
551. Universidad (*University*). [i]

URUGUAY.

Montevideo.

553. Bureau de Statistique (*Statistical Bureau*). [i]
555. Government of Uruguay.
557. Ministère de Finance (*Treasury Department*). [i]
559. Ministère de la Guerre (*War Department*). [i]
561. Société de Médicine (*Medical Society*). [i]
563. United States Consulate. [i]

VENEZUELA.

Caracas.

565. Escuela Médica (*Medical School*). [i]
567. Gazeta Cientifica (*Scientific Gazette*). [i]
569. La Union Médica—Organo del Gremio Médico de Venezuela (*Medical Union;—Organ of the Medical Society of Venezuela*).
571. Sociedad de Ciencias Fisicas y Naturales (*Society of Physical and Natural Sciences*).
573. Sociedad Economica de Amigos del Pais (*Economical Society of the Friends of Peace*). [iii]
575. Universidad de Caracas (*University of Caracas*).

ASIA.

BRITISH BURMAH.

Rangoon.

577. The Chief Engineer of British Burmah.

CHINA.

Canton.

579. Deputy of the Bureau of Foreign Affairs. [i]

Hong-Kong.

581. Meteorological Observatory.

Pekin.

583. Imperial Tungwen College. [i]
585. Kung-Pu (*Board of Works*).

Shanghai.

[Chinese Educational Mission School—does not exist.]
587. Chinese Government Department for the Translation of Foreign Scientific Books.
589. Chinese Polytechnic Institution and Reading Room.
591. Chinese Scientific and Industrial Magazine.
593. Imperial Chinese Maritime Customs, Engineer's Office. [i]
[Kwong-Ki-Chiu. (See Deputy of the Bureau of Foreign Affairs in Canton.)]
595. Literary and Debating Society.
597. Magnetic and Meteorological Observatory of the Imperial Russian Legation. [i]
599. Royal Asiatic Society (China Branch). [Care of James Bairn, 1 Haymarket, London, England.] [iii]
[Scientific Society—does not exist.]
601. Statistical Department of Inspector-General of Customs.
603. Zi-Ka-Wei Observatory. [i]

INDIA.

Allahabad.

607. Meteorological Reporter to the Government. [i]

Benares.

609. Sanscrit College. [i]

Bombay.

611. Agricultural Department of the Bombay Presidency.
613. Bombay Geographical Society. [iii]
615. Bombay Government. [i]
617. Geological Society.
619. Government Central Museum. [i]
621. Government College (formerly Bombay University). [i]
623. Government Observatory, Colaba. [i]
625. Literary Society of Bombay.
627. Meteorological Office. [i]
629. Royal Asiatic Society (Bombay Branch). [iii]
631. Sassoon Mechanics' Institute. [i]
633. Sir Jamsetjee Jeejeebhoy Translation Fund. [i]
635. "The Indian Antiquary." [i]

Calcutta.

637. Agricultural and Horticultural Society of India. [i]
639. Asiatic Society of Bengal. [iii]
641. Chamber of Commerce. [i]
643. Geological Survey of India. [Packages to be sent to the care of Trübner & Co., London, England.] [iii]
645. Imperial Indian Museum. [i]
647. Indian Medical Gazette. [i]
649. Indian Museum.
651. Medical and Physical Society. [i]
653. Meteorological Office. [i]
655. Revenue and Agricultural Department. [i]
657. St. Xavier's College.
659. Surgeon-General's Office.
661. Under Secretary to Government of Bengal. [i]

Colombo (*Ceylon*).

663. Government of Ceylon. [i]
665. Observatory of Mr. Green. [i]
667. Office of the Meteorological System. [i]
669. Royal Asiatic Society (Ceylon Branch). [iii]

Dehra-Dun.

671. Great Trigonometrical Survey of India. [i]

Goa.

673. Escola Medico-Cirurgica (*Medico-Surgical School*). [Packages to be sent through the Escola Polytechnica, Lisbon, Portugal.] [i]

Jaffna (*Ceylon*).

675. Jaffna College. [i]

Kurrachee.

677. Municipal Library and Museum. [i]

Madras.

679. Archæological Survey of Southern India.
681. East India Company's Office. [i]
683. Government Central Museum and Library. [i]
685. Literary Society. [iii]
687. Madras Journal of Literature and Science.
689. Madras Observatory. [i]
691. "Theosophist."

Neilgherries.

693. Public Library. [i]

Poonah.

695. Civil Engineering College.

Roorkee.

697. Thomason College of Civil Engineering. [iii]

Saharaupus.

698. Government Botanical Garden.

Simla.

699. Revenue and Agricultural Department, Government of India.
701. Surgeon-General of India.
703. United Service Institution of India. [i]

Trevandrum.

705. Observatory of His Highness the Rajah of Travancore. [i]
707. Trevandrum Museum.

JAPAN.

Tokio.

709. Emperor of Japan. [i]
711. Agricultural Bureau of Japan.
713. Asiatic Society of Japan (formerly in Yokohama). [i]
715. Chi-ga-ku-kio-kuwai (*Geographical Society*). [i]
717. Chi-shi-tsu-kio-ku (*Bureau of Geological Surveying*). [Commerce and Agricultural Department.]
719. Department of Law, Science, and Literature in the Tokio Daigaku.
721. Deutsche Gesellschaft für Natur- und Völkerkunde Ost-Asiens (*German Society of Natural History and Ethnology of Eastern Asia*). [i]
723. Kiyoiku Hakubutsukwan (*Educational Department*).
725. Minister of Foreign Affairs.
727. Mombusho Museum (*Educational Museum of the Imperial University*). [Care of Kiyoiku Hakubusukwan.] [iii]
729. Observatory of the Tokio Daigaku. [i]
731. Roma-Ji-Kwai (*Society for the Translation of Japanese in Roman Letters*).

Tokio—Continued.

733. Seismological Society of Japan.
735. Sci-I-Kwai (*Society for the Advancement of Medical Science*).
737. Society of Health.
739. Tokio Daigaku (*Imperial University*). [Formerly Káisei Gakko]. [iii]
741. Tokio Dzushokwan (Tokio Library).

Yokohama.

743. Deutsche Gesellschaft für Naturwissenschaft und Heilkunde (*German Society for Natural and Medical Sciences*).
745. Imperial College. [i]
747. Japanese Gazette.

JAVA.

Batavia.

749. Bataviaasche Genootschap van Kunsten en Wetenschappen (*Batavian Academy of Arts and Sciences*). [iii]
751. Geneeskundige Vereeniging in Nederlandsch-Indië (*Medical Association of Netherlands-India*). [i]
753. Koninklijke Naturkundige Vereeniging in Nederlandsch-Indië (*Royal Natural History Society of Netherlands-India*). [iii]
755. Magnetic and Meteorological Observatory. [i]
757. Nederlandsch-Indische Maatschappij van Nijverheid en Landbouw (*Industrial and Agricultural Society of Netherlands-India*). [i]
759. Tidschrift for Indische Taal- Land- en Volkenkunde (*Journal of Indian Philology and Folklore*).
761. Tidschrift for Nederlandsch-Indië (*Gazette of Netherlands-India*). [i]

Buitenzorg.

763. Botanischer Garten (*Botanical Garden*).

Samarang.

765. Indisch Aardrijkskundig Genootschap (*Indian Geographical Society*). [i]

PHILIPPINE ISLANDS.

Manila.

767. Horto Botanico Manilensis (*Botanical Garden of Manila*). [i]
769. Observatorio Meteorologico del Ateneo Municipal (*Meteorological Observatory of the Municipal University*). [i]
771. Royal Economical Society. [iii]

STRAITS SETTLEMENT.

Singapore.

773. Convict Jail Hospital. [i]
775. Raffles Library and Museum. [i]
777. Royal Asiatic Society. [i]

AUSTRALASIA.

AUSTRALIA.

NEW SOUTH WALES.

Sydney.

779. Agricultural Society of New South Wales. [i]
781. Australian Museum. [i]
783. "Australian Practitioner." [i]
785. Corporation of the City of Sydney. [i]
787. Council of Education. [i]
789. Free Public Library. [i]
791. Geographical Institute. [i]
793. Geographical Society of Australasia (New South Wales Branch).
795. Government of New South Wales. [i]
797. Government Observatory. [i]
799. Linnean Society of New South Wales. [i]
801. Mining Department. [i]
803. Parliamentary Library.
805. Royal Society of New South Wales. [iii]
807. Sydney College Library. [i]
809. Technical and Working Men's College.
811. University of Sydney. [iii]

Windsor.

813. Private Observatory of John Tebbutt. [i]

QUEENSLAND.

Brisbane.

815. Acclimatization Society. [i]
817. Colonial Secretary's Office. [i]

[Government of Queensland. (See Colonial Secretary's Office.)]

819. Government Meteorological Observatory. [i]
821. Parliamentary Library. [i]
823. Queensland Museum of Natural History.
825. Registrar-General.
827. Royal Society of Queensland.

Townsville.

829. Geological Survey of Queensland.

SOUTH AUSTRALIA.

Adelaide.

831. Adelaide University. [i]
835. Astronomical Observatory. [i]
837. Government Botanic Garden. [i]
839. Government of South Australia. [i]
841. Inspector-General of Schools. [i]
843. Parliamentary Library. [i]
845. Royal Society of South Australia. [i]
847. South Australia Institute. [i]

TASMANIA.

Hobarton.

849. Government of Tasmania. [i]
851. Library of Parliament.
853. Magnetic and Meteorological Observatory. [i]
855. Museum of the Royal Society of Tasmania and Herbarium and Botanical Department.
857. Royal Society of Tasmania. [Packages sent through G. W. Wheatley & Co., 165 Leadenhall street, London, E. C.] [iii]
859. Tasmania Public Library. [i]

[Mechanics' Institute—closed.]

Launceston.

861. Launceston Public Library. [i]
863. Mechanics' Institute and School of Arts. [i]

VICTORIA.

Collingwood.

865. Field Naturalists' Club of Victoria. [i]

Emerald Hill.

867. Mechanics' Institute. [i]

Melbourne.

869. Australian Medical Journal. [i]
871. Botanical Garden. [i]
873. Corporation of the City of Melbourne. [i]
875. Department of Mines and Water Supply. [i]
877. Eclectic Association of Victoria. [i]
879. Field Naturalists' Club.
881. Geographical Society. [i]
883. Geological Survey of Victoria. [i]
885. Government of Victoria. [i]
887. Melbourne Museum.
889. Melbourne Observatory. [i]

[Mining Department. (See Department of Mines, &c.)]

Melbourne—Continued.

891. National Museum of Victoria. [i]
893. Natural History Society. [i]
895. Parliamentary Library.
897. Public Library, Museum, and National Gallery. [iii]
899. Royal British Branch Mint. [i]
901. Royal Philosophical Society of Victoria. [i]
903. Royal Society of Medicine. [i]
905. Royal Society of Victoria. [i]
907. Southern Science Record.
909. University of Melbourne. [iii]
911. Zoological and Acclimatization Society. [i]

WEST AUSTRALIA.

Perth.

913. Meteorological Superintendent. [i]

NEW ZEALAND.

Auckland.

915. Auckland Free Public Library. [i]
917. Auckland Institute. [i]
919. Auckland Museum.

Christchurch.

921. Canterbury Acclimatization Society. [i]
923. Canterbury Museum. [i]
925. Geological Survey of the Province of Canterbury. [i]
927. Philosophical Institute of Canterbury. [i]

Dunedin.

929. Otago Institute. [i]
931. Otago Museum. [i]
933. Otago University.

Hokitika.

935. Westland Institute. [i]

Invercargill.

937. Scotland Institute.

Nelson.

939. Nelson Association for the Promotion of Science and Industry. [i]
941. Nelson Institute. [i]

Wellington.

943. Chief Inspector of Weights and Measures. [i]
945. Colonial Botanic Garden. [i]
947. Colonial Laboratory. [i]

Wellington—Continued.

949. Colonial Museum and Geological Survey Department. [i]
951. Colonial Observatory. [i]
953. Government of New Zealand. [i]
955. Government Observatory. [i]
957. Government Printing Office.
959. Meteorological and Weather Department. [i]
961. New Zealand Geological Survey. [i]
963. New Zealand Institute. [ii]
965. New Zealand Public Library. [i]
966. Parliamentary Library. [iii]
967. Patent Office Library. [i]
978. Wellington Philosophical Society. [i]
969. Wellington Public Library. [i]
970. Westland Naturalists' and Acclimatization Society. [i]

POLYNESIA.

SANDWICH ISLANDS.

Honolulu.

971. Government Geological Survey.
972. Hawaiian Gazette.
973. Hawaiian Govenment Library.
974. Minister of the Interior.
975. Oahu College.

[Royal Agricultural Society has turned over its books to the Hawaiian Government Library.]

976. Scientific Society.

EUROPE.

AUSTRIA-HUNGARY.

Agram [Zagrab] (*Croatia*).

977. Gesellschaft für südslavische Alterthümer (*Society for South Slavic Antiquities*). [i]

979. Handels- und Gewerbe-Kammer für Kroatien (*Chamber of Commerce and Board of Trade for Croatia*). [i]

981. Kroatische Archäologische Gesellschaft (*Croatian Archæological Society*).

983. Kroatisch-Slavonische Landwirthschafts-Gesellschaft (*Agricultural Society*). [i]

985. Landwirthschaftliche Zeitung (*Agricultural Journal*). [i]

987. National Museum. [i]

989. Redaktion der "Gospodarski List" (*Editor of the "Gospodarski List."*) [i]

991. Südslavische Akademie der Wissenschaften und Künste (*South Slavic Academy of Science and Art*). [i]

993. Trogovaćko Obrtnićka Komora (*Statistical Bureau*). [i]

995. Universität (*University*). [i]

Bistritz (*Austria*).

997. Gewerbeschule (*Industrial School*). [i]

Bregenz (*Austria*).

999. Vorarlberger Museums-Verein (*Vorarlberg Museum Society*). [i]

Brünn (*Austria*).

1001. K. K. Mährisch-Schlesische Gesellschaft für Ackerbau, Natur- und Landeskunde (*Imperial Royal Moravian-Silesian Society of Agriculture, Natural History, and Geography*). [i]

1003. Mährisch-Schlesisches Blinden-Erziehungs-Institut (*Moravian-Silesian Institute for Educating the Blind*). [i]

1005. Naturforschender Verein (*Naturalists Society*) [iii]

Budapest (*Hungary*).

1007. Fövarosi statisztikai Hivatal (*Statistical Bureau*). [i]

1009. Geologische Gesellschaft für Ungarn (*Geological Society of Hungary*). [iii]

1011. Handels-Akademie (*Commercial Academy*) [i]

Budapest (*Hungary*)—Continued.

1013. Handels- und Gewerbe-Kammer (*Chamber of Commerce and Trade*). [i]
1015. Industrielle Gesellschaft (*Industrial Society*). [i]
1017. K. K. Egyetem Kathol. Fögymnasium (*Imperial Royal Catholic Gymnasium*). [i]
1019. K. K. Sternwarte (*Imperial Royal Observatory*).
1021. K. Geographisches Institut (*Royal Geographical Institute*).
1023. K. Magyar Természettudományi Társulat (*Royal Hungarian Society of Natural Sciences*). [iii]
1025. K. Magyar Tudományos Egyetem (*Royal Hungarian University*). [iii]
1027. K. Ober-Gymnasium (*Royal Higher Gymnasium*). [i]
1029. K. Ober-Realschule (*Royal Practical School*). [i]
1031. K. Ungar. Central-Anstalt für Meteorologie und Erdmagnetismus (*Royal Hungarian Central Institute of Meteorology and Terrestrial Magnetism*). [i]
1033. K. Ungar. Geologische Anstalt (*Royal Hungarian Geological Institute*). [i]
1035. Lebens-Versicherungs-Gesellschaft "Anker" (*"Anchor" Life Insurance Company*).
1037. Magyar Foldrajzi Tarsasag.
1039. Magyar Nemzeti Museum (*Hungarian National Museum*). [i]
1041. Magyar Tudományos Akademia (*Hungarian Academy*). [iii]
1043. Ministerium für Agricultur und Industrie (*Ministry of Agriculture and Industry*). [i]
1045. Musée d'Anthropologie de l'Université (*Anthropological Museum of the University*).
1047. Naturforschender Verein (*Natural History Society*).
1049. Oesterreich - Ungarische Staats - Eisenbahn - Gesellschaft (*Austro-Hungarian Railroad Society*). [Theresien Ring 30.]
1051. Pestváros Statisztikai Hivatal (*Statistical Bureau of the City*). [i]
1053. Polytechnische Schule (*Polytechnic School*).
1055. Präsidium des Königlich Ungarischen Ministeriums (*President of the Royal Hungarian Ministry*).
1057. Société de Géographie de Hongrie (*Hungarian Geographical Society*). [i]
1059. Termeszetrajzi Fuzetk.

Czernowitz (*Austria*).

1061. K. K. Universitäts-Bibliothek (*Imperial Royal University Library*). [iii]
1063. Verein für Landeskultur und Landeskunde im Herzogthume Bukowina (*Society for Agriculture and Geography of the Duchy of Bukowina*). [i]

Fiume (*Illyria*).

1065. K. K. Marine-Akademie (*Imperial Royal Naval Academy*). [i]

Galacz (*Austria*).

1067. Commission Européenne de Danube (*European Danube Commission*). [i]

Görz (*Illyria*).

1069. K. K. Ackerbau-Gesellschaft (*Imperial Royal Agricultural Society*). [i]

Grätz (*Styria*).

1071. Akademie für Handel und Industrie (*Academy of Commerce and Industry*). [i]
1073. Historischer Verein für Steiermark (*Historical Society of Styria*). [i]
1075. K. K. Erstes Staats-Gymnasium (*Imperial Royal State Gymnasium*). [i)
1077. K. K. Steiermärkischer Gartenbau-Verein (*Imperial Royal Styrian Horticultural Society*). [i]
1079. K. K. Steiermärkische Landwirthschafts-Gesellschaft (*Imperial Royal Styrian Agricultural Society*). [i]
1081. K. K. Universität (*Imperial Royal University*). [iii]
1083. Landes-Bibliothek am Steiermärk. Landschaftlichen Joanneum (*Styrian National Library at the Joanneum*). [i]
1085. Mineralogisches Museum des Steiermärkischen Landschaftlichen Joanneums (*Styrian National Mineralogical Museum of the Joanneum*).
1087. Naturwissenschaftlicher Verein für Steiermark (*Styrian Society of Natural Sciences*). [i]
1089. Steiermärkischer Industrie- und Gewerbe-Verein (*Styrian Industrial and Polytechnical Society*). [i]
1091. Steiermärkische Landes-Ober-Realschule (*Styrian Higher "Real" School*). [i]
1093. Verein der Aerzte in Steiermark (*Styrian Society of Physicians*). [i]

Hermannstadt (*Transylvania*).

1095. Siebenbürgischer Verein für Naturwissenschaften (*Transylvanian Society of Natural Sciences*). [iii]
1097. Verein für Siebenbürgische Landeskunde (*Transylvanian Geographical Society*). [i]

Innsbruck (*Tyrol*).

1099. Ferdinandeum. [iii]
1101. K. K. Nord-Tirolische Landwirthschafts-Gesellschaft (*Imperial Royal Agricultural Society of North Tyrol*). [i]
1103. Naturwissenschaftlich-Medicinischer Verein (*Society of Natural and Medical Sciences*). [i]
1105. Universitäts-Bibliothek (*University Library*). [i]

Kalocsa (*Hungary*).

1107. Sternwarte (*Observatory*).

Klagenfurth (*Carinthia*).

1109. Geschichts-Verein für Kärnten (*Historical Society of Carinthia*). [i]
1111. Handels- und Gewerbe-Kammer (*Chamber of Commerce and Board of Trade*). [i]
1113. Kärntnerischer Gartenbau-Verein (*Carinthian Horticultural Society*).
1115. Kärntnerischer Industrie- und Gewerbe-Verein (*Carinthian Industrial and Polytechnical Association*). [i]
1117. K. K. Landwirthschafts-Gesellschaft (*Imperial Royal Agricultural Society*). [i]
1119. K. K. Studien-Bibliothek (*Imperial Royal Collegiate Library*). [i]
1121. Naturhistorisches Landes-Museum in Kärnten (*Carinthian National Museum of Natural History*). [i]
1123. Section Klagenfurt des Berg- und Hüttenmännischen Vereines für Steiermark und Kärnten (*Klagenfurt Section of the Mining and Smelting Society of Styria and Carinthia*)

Klausenburg (*Transylvania*).

1125. Edelyi Museum Egylet (*National Museum*). [i]
1127. Königlicher Botanischer Garten (*Royal Botanical Garden*).
1129. Königlich Ungarische Universität (*Royal Hungarian University*).
1131. Magyar Növenytani Lapok. [i]

Kloster-neuburg (*Austria*).

1133. Revue Antiphylloxéique (*Anti-phylloxera Review*).

Krakau (*Galicia*).

1135. Akademija Umiejetnósci (*Academy of Sciences*). [i]
1137. Galizischer Fischerei-Verein (*Galician Piscicultural Society*). [i]
1139. K. K. Universitäts-Sternwarte (*Imperial Royal University Observatory*). [i]
1141. Medicinische Gesellschaft (*Medical Society*). [i]
1143. Universitet Jagiellonski (*Jagiellonski University*). [iii]

Kremsmünster (*Austria*).

1145. Sternwarte (*Observatory*). (i]

Laibach (*Illyria*).

1147. Historischer Verein für Krain (*Historical Society of Carniola*). [i]
1149. Juristische Gesellschaft (*Jurists' Association*). [i]

Laibach (*Illyria*)—Continued.

1151. K. K. Landwirthschafts-Gesellschaft (*Imperial Royal Agricultural Society*). [i]
1153. K. K. Studien-Bibliothek (*Imperial Royal Collegiate Library*).
1155. Landes-Museum (*National Museum*). [i]
1157. Matica Slovenska (*Literary Society*). [i]

Lemberg (*Galicia*).

1159. Franzens-Universität (*Francis University*).
1161. Universitäts-Sternwarte (*University Observatory*). [i]
1163. Zaklad narodowy imienia Ossolinskich (*National Institute*). [i]

Leoben (*Styria*).

1165. K. K. Berg-Akademie (*Imperial Royal Mining Academy*). [i]
1167. Oesterreichische Zeitschrift für das Berg- und Hüttenwesen (*Austrian Mining and Smelting Journal*).

Linz (*Austria*).

1169. Handels- und Gewerbe-Kammer Oberösterreichs (*Upper-Austrian Chamber of Commerce and Board of Trade*). [i]
1171. K. K. Landwirthschafts-Gesellschaft (*Imperial Royal Agricultural Society*). [i]
1173. K. K. offentliche Studien-Bibliothek (*Imperial Royal Collegiate Library*).
1175. Museum Francisco Carolinum (*Museum Francisco Carolinum*). [i]

Neutitschein (*Austria*).

1177. Landwirthschaftlicher Verein (*Agricultural Society*). [i]

O'Gyalla (*Hungary*).

1179. Astro-physikalisches Observatorium (*Astro-Physical Observatory*). [i]

Olmütz (*Moravia*).

1181. K. K. Deutsches Gymnasium (*Imperial Royal German Gymnasium*). [i]
1183. K. K. Ober-Realschule (*Imperial Royal High "Real" School*). [i]
1185. K. K. Studien-Bibliothek (*Imperial Royal Collegiate Library*). [iii]

Pola (*Illyria*).

1187. Hydrographisches Amt (*Hydrographic Office*). [i]

Prag (*Bohemia*).

1189. Böhmische chemische Gesellschaft (*Bohemian Chemical Society*). [i]
1191. Böhmischer Gewerbe-Verein (*Bohemian Polytechnical Society*). [i]

Prag (*Bohemia*)—Continued.

1193. Comité für naturwissenschaftliche Landesdurchforschung. (*Committee for Natural History Explorations*). [i]
1195. Deutscher polytechnischer Verein (*German Polytechnical Society*). [i]
1197. K. böhmische Gesellschaft der Wissenschaften (*Royal Bohemian Society of Sciences*). [iii]
1199. K. böhmisches Museum (*R. Bohemian Museum*). [iii]
1201. K. K. böhmische Carl Ferdinand Universität (*Imperial Royal Bohemian Carl Ferdinand University*).
1203. K. K. böhmische technische Hochschule (*Imperial Royal Bohemian Polytechnicum*).
1205. K. K. deutsche Carl Ferdinand Universitäts-Bibliothek (*Imperial Royal German Carl Ferdinand University Library*). [iii]
1207. K. K. deutsche technische Hochschule (*Imperial Royal German Polytechnicum*).
1209. K. K. Universitäts-Sternwarte (*Imperial Royal University Observatory.*) [i]
1211. Medicinische Facultät (*Medical Faculty*). [i]
1213. Naturwissenschaftlicher Verein "Lotos" (*Society of Natural Sciences "Lotos"*). [i]
1215. Památky archaeologické a mistopisme.
1217. Præsidium des Landes-Kultur-Rathes (*President of the Council for Agriculture*). [iii]
1219. Redaktion der technischen Blätter (*Technical Journal*). [i]
1221. Schaafzüchter-Verein für Böhmen (*Sheep-breeders' Society of Bohemia*). [i]
1223. Verein für die Geschichte der Deutschen in Böhmen (*Society for the History of the Germans in Bohemia*). [i]
1225. Verein zur Ermunterung des Gewerbegeistes in Böhmen (*Society for the Encouragement of Industrial Enterprise in Bohemia*). [i]

Presburg (*Hungary*).

1227. Handels- und Gewerbe-Kammer (*Chamber of Commerce and Board of Trade*). [i]
1229. Verein für Naturkunde (*Society of Natural Sciences*). [i]

Přibram (*Bohemia*).

1231. K. K. Berg-Direction (*Imperial Royal Direction of Mines*) [K. K. Karoli Boromäi Silber- und Blei-Hauptwerk]. [i]

Reichenberg (*Bohemia*).

1233. Verein der Naturfreunde (*Society of Naturalists*).

Roveredo (*Tyrol*).

1235. I. R. Accademia di Lettere e Scienze degli Agiati (*Imperial Royal Academy of Letters and Sciences*). [i]
1237. I. R. Scuola Reale Elisabettina (*Imperial Royal Elizabeth School*). [i]

St. Pölten (*Austria*).

1239. Nieder-österr. Landes-Ober-Realschule (*National High School of Lower Austria*). [i]

Salzburg (*Austria*).

1241. K. K. Landwirthschafts-Gesellschaft (*Imperial Royal Agricultural Society*). [i]
1243. K. K. Studien- Bibliothek (*Imperial Royal Collegiate Library*). [i]
1245. Städtisches Museum Carolino-Augusteum (*Municipal Carolino-Augustan Museum*).

Schässburg (*Austria*).

1247. Gymnasium (*Gymnasium*). [i]

Trent (*Tyrol*).

1249. Oesterreichischer Alpen-Verein (*Austrian Alpine Club*). [i]
1251. Società degli alpinisti Tridentini (*Alpine Club of Trent*). [i]
1253. R. Istituto Industriale e Professionale (*Royal Industrial and Professional Institute*).

Trieste (*Illyria*).

1255. Ackerbau-Gesellschaft (*Agricultural Society*). [i]
1257. Astronomisches und meteorologisches Observatorium der nautischen Akademie (*Astronomical and Meteorological Observatory of the Nautical Academy*).
1259. Civico Museo di Storia Naturale Ferdinando-Massimiliano (*Ferdinand Maximilian Museum of Natural History*). [i]
1261. Gartenbau-Gesellschaft (*Horticultural Society*).
1263. K. K. Handels- und nautische Akademie (*Imperial Royal Commercial and Nautical Academy*). [i]
1265. "L' Ortolano," Giornale Populare d' Orticultura, "*The Gardener"—Popular Horticultural journal*). [i]
1267. Società Adriatica di Scienze Naturali (*Adriatic Society of Natural Sciences*). [i]
[Società Agraria. (See Ackerbau-Gesellschaft.)]
1271. Società par la Lettura Populare (*Society for Popular Lectures*). [i]
1273. Società Scientifica Letteraria della Minerva (*Minerva Scientific Literary Society*). [iii]

Wien (*Austria*).

1275. Seiner Kaiserlich-Königlichen Majestät Privat-Bibliothek (*Private Library of His Majesty the Emperor*). [iii]

Wien (*Austria*)—Continued.

1277. Afrikanische Gesellschaft (*African Society*).
1279. Allgemeiner Oesterr. Apotheker-Verein (*Austrian Apothecaries' Association*). [i]
1281. Allgemeine Wiener medicinische Zeitung (*Vienna Medical Journal*). [i]
1283. Alterthums-Verein [1 Universitäts-Platz, 2] (*Archæological Society*).
1285. Anthropologische Gesellschaft (*Anthropological Society*). [i]
1287. Chemisch-metallurgisches Laboratorium [Rasumoffskigasse, 3] (*Chemico-Metallurgical Laboratory*).
1289. Chemisch-physikalische Gesellschaft (*Chemico-Physical Society*).
1291. Deutsche Rundschau für Geographie und Statistik (*German Review for Geography and Statistics*).
1293. Entomologischer Verein (*Entomological Society*). [i]
1295. Geologisches Institut der Universität (*Geological Institute of the University*).
1297. Handels- und Gewerbe Kammer (*Chamber of Commerce and Board of Trade*). [i]
1299. Kaiserliche Akademie der Wissenschaften [Universitäts-Platz 2] (*Imperial Academy of Sciences*). [iii]
1301. K. K. Ackerbau-Ministerium [Rudolph-Platz, 13A] (*Imperial Royal Department of Agriculture*). [i]
1303. K. K. Akademie für Bildende Künste [Schiller-Platz 3] (*Imperial Royal Academy of Plastic Art*).

[K. K. Artillerie- und Ingenieur-Schule (*Imperial Royal Artillery and Engineers' School*). (See K. K. Technische Militair-Akademie.)]

1305. K. K. Botanisches Hof-Cabinet (*Imperial Royal Botanical Museum*).
1307. K. K. Central-Anstalt für Meteorologie und Erdmagnetismus [Hohe Warte bei Döbling, No. 38, Wien] *Imperial Royal Central Institute for Meteorological and Terrestrial Magnetism*). [i]
1309. K. K. Central-Kommission zur Erforschung und Erhaltung der Kunst- und historischen Denkmale [Schiller-Platz, 4] (*Imperial Royal Central Commission for the Exploration and Preservation of Art and Historical Monuments*).
1311. K. K. Gartenbau-Gesellschaft (*Imperial Royal Horticultural Society*). [i]
1313. K. K. General-Stabs-Schule (*Imperial Royal School of Staff*).
1315. K. K. Geographische Gesellschaft (*Imperial Royal Geographical Society*). [iii]
1317. K. K. Geologische Reichsanstalt (*Imperial Royal Geological Establishment*). [iii]

Wien (*Austria*)—Continued.

1319. K. K. Gesellschaft der Aerzte (*Imperial Royal Society of Physicians*). [i]
1321. K. K. Handels-Ministerium (*Imperial Royal Department of Commerce*). [i]
1323. K. K. Hochschule für Bodencultur [vii. Landesgasse, 17] (*Imperial Royal Agricultural High School*).
1325. K. K. Hof-Bibliothek (*Imperial Royal Library*). [iii]
1327. K. K. Hof- und Staats-Druckerei (*Imperial Royal State Printing Office*). [iii]
1329. K. K. Kriegs-Ministerium (*Imperial Royal War Department*). [i]
1331. K. K. Landes-Vertheidigungs-Ministerium (*Imperial Royal Department of National Defense*).
1333. K. K. Marine-Ober-Kommando (*Imperial Royal Naval Office*). [i]
1335. K. K. Militär Geographisches Institut (*Imperial Royal Military Geographical Institute*).
1337. K. K. Mineralogisches Hof-Cabinet (*Imperial Royal Mineralogical Museum*).
1339. K. K. Ministerium des Aeussern (*Imperial Royal Foreign Office*). [i]
1341. K. K. Ministerium für Cultus und Unterricht (*Imperial Royal Department of Church and Education*). [i]
1343. K. K. Ministerium des Innern (*Imperial Royal Department of the Interior*). [i]
1345. K. K. Naturhistorisches Hof-Museum (*Imperial Royal Natural History Museum*). [ii]
1347. K. K. Ober-Gymnasium zu den Schotten (*Imperial Royal Schotten Gymnasium*). [i]
1349. K. K. Oeffentliche Lehranstalt für orientalische Sprachen [Universitäts-Platz, 1] (*Imperial Royal Public Institute of Oriental Languages*).
1351. K. K. Oesterr. Museum für Kunst und Industrie (*Imperial Royal Museum of Art and Industry*). [i]
1353. K. K. Physikalisch-astronomisches Hof-Cabinet (*Imperial Royal Physical-Astronomical Museum*).
1355. K. K. Reichs - Landwirthschafts - Gesellschaft (*Imperial Royal Agricultural Society*). [i]
1357. K. K. Schottenfelder Ober-Realschule (*Imperial Royal Schottenfeld High School*). [i]
1359. K. K. Statistische Central-Kommission (*Imperial Royal Statistical Central Commission*). [iii]
1361. K. K. Sternwarte (*Imperial Royal Observatory*). [i]
1363. K. K. Technische Hochschule (*Imperial Royal Polytechnicum*).

Wien (*Austria*)—Continued.

1365. K. K. Technische Militair-Akademie (*Imperial Royal Technical Military Academy*) [formerly K. K. Artillerie- und Ingenieur-Schule].
1367. K. K. Topographische Gesellschaft (*Imperial Royal Topographical Society*).
1369. K. K. Universitäts-Bibliothek (*Imperial Royal University Library*). [iii]
1371. K. K. Zoologisch-Botanische Gesellschaft (*Imperial Royal Zoological Botanical Society*). [ii]
1373. K. K. Zoologisches Hof-Cabinet (*Imperial Royal Zoological Museum*). [i]
1375. Marine-Section des K. K. Reichs-Kriegs-Ministeriums (*Naval Section of the Imperial Royal State, War Department*). [i]
1377. Naturwissenschaftlicher Verein (*Society of Natural Sciences*).
1379. Niederösterreichischer Gewerbe-Verein (*Polytechnical Society of Lower Austria*). [i]
1381. Numismatische Gesellschaft (*Numismatic Society*).
1383. Oesterreichische Gesellschaft für Meteorologie (*Austrian Society of Meteorology*). [i]
1385. Oesterreichischer Ingenieur- und Architecten-Verein (*Austrian Society of Engineers and Architects*). [i]
1387. Orientalische Akademie (*Oriental Academy*).
1389. Orientalisches Museum (*Oriental Museum*). [i]
1391. Ornithologischer Verein (*Ornithological Society*). [i]
1393. Pharmaceutische Gesellschaft (*Pharmaceutical Society*).
1395. Photographische Gesellschaft (*Photographical Society*). [i]

[Polytechnische Gesellschaft (*Polytechnical Society*). (See K. K. Technische Hochschule.)]

1397. Privilegirte österreich-ungarische Staats-Eisenbahn-Gesellschaft [Schwarzenberg-Platz, 3] (*Austro-Hungarian Railroad Society*).
1399. Redaktion: Neue Freie Presse (*New Free Press*).

[Redaktion: Oesterr.-ungar. Fischerei-Zeitung (*Austria-Hungary Fishing Gazette*). Defunct.]

1401. Redaktion: Oesterr.-ungar. Sparkassen-Zeitung (*Austria-Hungary Savings Bank Gazette*).
1403. Redaktion: Der Gartenfreund (*The Garden's Friend*).
1405. Redaktion: Photographische Correspondenz (*Photographic Correspondence*).
1407. Redaktion: Numismatische Zeitschrift [formerly Monatshefte] (*Numismatic Gazette*). [i]
1409. Redaktion: Die neuesten Erfindungen im Gebiete der Landwirthschaft (*The latest discoveries in agriculture—journal*).
1411. Redaktion: Ungarische Revue (*Hungarian Review*). [i]

Wien (*Austria*)—Continued.

1413. Redaktion: Wiener Medizinische Wochenschrift (*Medical Weekly*).

[Redaktion: Wiener Numismatische Monatshefte (*Vienna Numismatic Monthly*). See Numismatische Zeitschrift.]

1415. Redaktion: Wiener Obst- und Garten-Zeitung (*Vienna Fruit and Horticultural Journal—published by the Imperial Royal Horticultural Society*). [i]

1417. Stadt-Verwaltung (*City council*).

1419. Technologisches Gewerbe-Museum (*Polytechnical Museum*).

1421. Unterstützungs-Verein für entlassene Strafgefangene, sowie für hülfs- und schuldlose Familien von Verhafteten (*Society to assist released prisoners and their families*).

1423. Verein der Geographen an der K. K. Universität (*Society of Geographers of the Imperial Royal University*). [i]

1425. Verein der K. K. autor. und beeideten Civil-Ingenieure und Architekten (*Society of Civil Engineers and Architects*).

1427. Verein der Literaturfreunde (*Society of the Friends of Literature*).

1429. Verein der Montan und Eisen Industriellen (*Society of Iron Industry*).

1431. Verein für Psychiatrie und Forensische Psychologie (*Society of Psychiatry and Forensic Psychology*).

1433. Verein zur Verbreitung naturwissenschaftlicher Kenntnisse (*Society for the diffusion of the knowledge of Natural Sciences*). [i]

1435. Verein zur Versorgung und Beschäftigung erwachsener Blinden (*Society for the Support and Employment of the adult Blind*). [i]

1437. Wiener Handel's-Akademie (*Vienna Commercial Academy*).

1439. Wiener Thierschutz-Verein (*Vienna Society for the Prevention of Cruelty to Animals*). [i]

1441. Wissenschaftlicher Club (*Scientific Club*). [i]

1443. Wissenschaftlicher Verein der Militär-Aerzte der Wiener Garnison (*Scientific Society of Army Physicians of the Vienna Garrison*).

Zara (*Dalmatia*).

1445. Società Economica di Dalmazia (*Economical Society of Dalmatia*). [i]

BELGIUM.

Anvers (*Antwerp*).

1447. Académie d'Archéologie de Belgique (*Academy of Archæology of Belgium*). [i]

1449. Académie Royale des Beaux Arts (*Royal Academy of Fine Arts*). [i]

Anvers (*Antwerp*)—Continued.

1451. Administration Communale (*City Government*).
1453. Bibliothèque Publique de la ville (*Public City Library*). [i]
1455. Cercle Artistique, Littéraire et Scientifique d'Anvers (*Artistic, Literary, and Scientific Society of Anvers*). [i]
1457. Société Belge de Géographie (*Belgium Geographical Society*). [i]
1459. Société Chorale Dramatique et Littéraire—De Vlaamsche Vrienden—(*Choral Dramatic and Literary Society of Flemish friends*).
1461. Société de Médecine (*Medical Society*). [i]
1463. Société de Olytak (*Society Olytak*).
1465. Société de Pharmacie (*Pharmaceutical Society*). [i]
1467. Société Royale pour l'Encouragement des Beaux Arts (*Royal Society for the Encouragement of Fine Arts*). [i]
1469. Société Royale d'Horticulture et d'Agriculture (*Royal Society of Horticulture and Agriculture*). [i]
1471. Société Royale de Zoologie (*Royal Zoological Society*). [i]

Arlon.

1473. Bibliothèque Publique (*Public Library*). [i]

Ath.

1475. Bibliothèque Publique (*Public Library*). [i]

Audenarde.

1477. Bibliothèque Publique (*Public Library*). [i]

Bruges.

1479. Administration Communale (*City Government*). [i]
1481. Archives de l'Administration Communale (*Archives of the City Government*).
1483. Bibliothèque Publique (*Public Library*). [i]
1485. Cercle Artistique et Littéraire (*Artistic and Literary Society*).
1487. Société d'Horticulture et de la Botanique (*Horticultural and Botanical Society*). [i]
1489. Société Médico-Chirurgicale de Bruges (*Medico Chirurgical Society of Bruges*). [i]

Bruxelles (*Brussels*).

1491. Académie Royale de Médecine (*Royal Academy of Medicine*). [i]
1493. Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique (*Royal Academy of Sciences, Letters, and Fine Arts, of Belgium*). [iii]
1495. Archives Médicales (*Medical Archives*). [i]
1497. Association Internationale pour l'exploration et la civilisation de l'Afrique Central (*International Society for the exploration and civilization of Central Africa*).

Bruxelles (*Brussels*)—Continued.

1499. Athénée Belge (*Belgian Athenæum*). [i]
1501. Bibliothèque de la Chambre des Représentants (*Library of the House of Representatives*). [i]
1503. Bibliothèque Royale de Belgique (*Royal Library of Belgium*). [iii]
1505. Bibliothèque de l'Université (*University Library*). [i]
1507. Cercle Artistique et Littéraire (*Artistic and Literary Society*).
1509. Commission Administrative du Musée Royal de l'Industrie (*Administrative Commission of the Royal Museum of Industries*). [i]
1511. Commission Belge des Échanges Internationaux (*Belgian Commission of International Exchanges*). [i]
1513. Commission Centrale de Statistique (*Central Commission of Statistics*). [i]
1515. Commission de Contrôle de la Carte Géologique de Belgique (*Commission for the Geological Map of Belgium*).
1517. Commission des Annales des Travaux Publiques (*Commission of Record of Public Works*). [i]
1519. Commission Royale d'Histoire (*Royal Commission of History*). [i]
1521. Gouvernement de la Belgique (*Government of Belgium*). [i]
1523. Institut de Droit International (*Institute of International Laws*). [i]
1525. Institut Cartographique Militaire (*Military Cartographical Institute*).
1527. Institut Géographique de Bruxelles [20 Rue de Paroissiens] (*Geographical Institute of Brussels*). [i]
1529. Ministère des Affaires Étrangéres (*Foreign Office*).
1531. Ministère d'Agriculture (*Agricultural Department*).
1533. Ministère de l'Intérieur (*Interior Department*). [i]
1535. Musée Royal d'Antiquités, d'Armures et d'Artillerie (*Royal Museum of Antiquities, Armor and Ordnance*). [i]
1537. Musée Royal d'Histoire Naturelle de Belgique (*Royal Natural History Museum of Belgium*). [ii]
1539. Observatoire Royal (*Royal Observatory*). [iii]
1541. Société Anatomo-Pathologique (*Anatomo-Pathological Society*).
1543. Société d'Anthropologie de Bruxelles (*Anthropological Society of Brussels*).
1545. Société [Royale] Belge de Géographie (*Royal Belgian Geographical Society*). [i]
1547. Société Belge de Médecine Homœopathique (*Belgian Society of Homœopathic Medicine*). [i]

Bruxelles (*Brussels*)—Continued.

1549. Société Belge de Microscopie (*Belgian Microscopical Society*). [i]
1551. Société Centrale d'Agriculture de Belgique (*Central Agricultural Society of Belgium*). [i]
1553. Société Centrale des Instituteurs Belges (*Central Association of Belgian Teachers*). [i]
1555. Société d'Histoire et d'Archéologie (*Society of History and Archæology*).
1557. Société des Électriciens de Belgique (*Society of Electricians of Belgium*).
1559. Société Entomologique de Belgique (*Entomological Society of Belgium*). [ii]
1561. Société Malacologique de Belgique (*Malacological Society of Belgium*). [i]
1563. Société Royale de Numismatique Belge (*Royal Numismatic Society of Belgium*). [i]
1565. Société Royale de Pharmacie de Bruxelles (*Royal Society of Pharmacy of Brussels*). [i]
1567. Société Royale de Botanique de Belgique (*Botanical Society of Belgium*). [i]
1569. Société Royale de Flore (*Royal Society of Flora*). [i]
1571. Société Royale Linnéenne de Bruxelles (*Royal Linnean Society of Brussels*). [i]
1573. Société Royale Protectrice des Animaux (*Royal Society for the Protection of Animals*). [i]
1575. Société Royale des Sciences Médicales et Naturelles (*Royal Society of Medical and Natural Sciences*). [i]
1577. Société Scientifique de Bruxelles (*Scientific Society of Brussels*). [i]
1579. Société Vésalienne (*Vesalian Society*).

Charleroi.

1581. Bibliothèque Publique (*Public Library*). [i]
1583. Société Paléontologique et Archéologique de l'Arrondissement (*Paleontological and Archæological Society of the District*). [i]

Courtray.

1585. Bibliothèque Publique (*Public Library*). [i]

Furnes.

1587. Bibliothèque Publique (*Public Library*). [i]

Gand (*Ghent*).

1589. Administration de la Revue et des Archives de Droit International et de Législation Comparée (*Administration of the Revisal and Records of International Law and Comparative Legislation*). [i]

Gand (*Ghent*)—Continued.

1591. Maatschappij van Nederlandsche Letterkunde en Geschiedenes (*Society of the Literature and History of Netherlands*). [i]
1593. Société d'Histoire Naturelle (*Natural History Society*). [i]
1595. Société de Médecine (*Medical Society*). [i]
1597. Société Royale d'Agriculture et de Botanique (*Royal Society of Agriculture and Botany*). [i]
1599. Société Royale des Beaux Arts et de Littérature (*Royal Society of Fine Arts and Literature*). [i]
1601. Société Het Willems-fonds (*Willems-fund* [*Philological*] *Society*). [i]
1603. Université (*University*). [iii]

Hasselt.

1605. Bibliothèque Communale (*City Library*). [i]
1607. Bibliothèque Publique (*Public Library*). [i]

Huy.

1609. Cercle des Sciences et Beaux Arts (*Circle of Sciences and Fine Arts*). [i]

Liège.

1611. Association des Ingénieurs sortis de l'École de Liège (*Association of Engineers of the School of Liège*). [i]
1613. Comité du Cercle Industriel (*Committee of the Industrial Circle*). [i]
1615. Conseil de Salubrité Publique de la Province de Liège (*Board of Public Health of the Province of Liège*). [i]
1617. École des Mines (*Mining Academy*).
1619. Fédération des Sociétés d'Horticulture de Belgique (*Association of the Horticultural Societies of Belgium*). [i]
1621. Institut Archéologique Liègeois (*Archæological Institute of Liège*). [i]
1623. Revue Universelle des Mines, de la Métallurgie, des Travaux Publics, &c. (*Review of Mines, Metallurgy, Public Works, &c.*). [i]
1625. Société Géologique de Belgique (*Geological Society of Belgium*). [i]
1627. Société libre d'Émulation pour l'Encouragement des Lettres et des Beaux Arts (*Free Emulative Society for the Promotion of Letters, Sciences, and Arts*). [i]
1629. Société des Sciences Naturelles (*Society of Natural Sciences*). [i]
1631. Société Liègeoise de Littérature Wallone (*Liège Society of Walloon Literature*). [i]
1633. Société de Médecine (*Medical Society*). [i]

Liège—Continued.

1635. Société Médico-chirurgicale de Liège (*Medico-chirurgical Society of Liège*). [i]
1637. Société Royale d'Horticulture (*Royal Horticultural Society*). [i]
1639. Société Royale des Sciences (*Royal Society of Sciences*). [iii]
1641. Université de l'État (*State University*). [i]

Lokeren.

1643. Bibliothèque Publique (*Public Library*). [i]

Louvain.

[Bibliothèque Publique—does not exist.]
1645. "Le Muséon." Revue Internationale, rue du Vent 8 ("*The Museum;"—International Review*).
1647. Société Littéraire de l'Université Catholique (*Literary Society of the Catholic University*). [i]
1649. Studenten Genootschap der Katholische Hoogeschool (*Students' Association of the Catholic University*).
1651. Université Catholique (*Catholic University*). [iii]

Melle (*near Ghent*).

1653. Institution Littéraire, Scientifique, Commerciale et Industrielle (*Literary, Scientific, Commercial, and Industrial Institution*). [i]
1655. Muséum Commercial et Industriel (*Commercial and Industrial Museum*). [i]

Mons.

1657. Bibliothèque Publique (*Public Library*). [i]
1659. Cercle Archéologique (*Archæological Circle*). [i]
1661. Société des Anciens Élèves de l'École des Mines du Hainaut (*Society of the Former Pupils of the School of Mines of Hainaut*). [i]
1663. Société des Bibliophiles Belges (*Society of Belgian Bibliophilists*). [i]
1665. Société des Sciences, des Arts et des Letters du Hainaut (*Society of Sciences, Arts, and Letters of Hainaut*). [iii]

Namur.

1667. Bibliothèque Publique (*Public Library*). [i]
1669. Cercle Artistique et Littéraire (*Artistic and Literary Circle.*) [i]
1671. Société Agricole et Forestière de la Province de Namur (*Society of Agriculture and Forestry of the Province of Namur*). [i]
1673. Société Archéologique (*Archæological Society.*) [i]

Ostend.

1675. Bibliothèque Publique (*Public Library*). [i]

St. Nicolas.

1677. Bibliothèque Publique (*Public Library*). [i]
1679. Cercle Archéologique du Pays de Waas (*Archæological Circle of Waas*). [i]

Termonde.

1681. Bibliothèque Spéciale Termondoise (*Library*). [i]
1683. Cercle Archéologique de la Ville et de l'Ancien Pays de Termonde (*Archæological Circle of the City and the Ancient Territory of Termonde*). [i]

Tirlemont.

1685. Bibliothèque Publique (*Public Library*). [i]

Tongres.

1687. Société Scientifique et Littéraire du Limbourg (*Scientific and Literary Society of Limburg*). [i]

Tournay.

1689. Bibliothèque Publique (*Public Library*). [i]
1691. Société Historique et Littéraire de Tournay (*Historical and Literary Society of Tournay*). [i]
1693. Société Royale d'Horticulture et d'Agriculture (*Royal Society of Horticulture and Agriculture*).

Verviers.

1695. Bibliothèque Communale (*City Library*). [i]
1697. Chambre de Commerce de Verviers (*Chamber of Commerce of Verviers*). [i]
1699. Société Archéologique de Verviers (*Archæological Society of Verviers*).
1701. Société Industrielle et Commerciale (*Industrial and Commercial Society*). [i]
1703. Société Royale d'Agriculture et de Botanique (*Royal Society of Agriculture and Botany*). [i]

Ypres.

1705. Bibliothèque Publique (*Public Library*). [i]
1707. Société Historique, Archéologique, et Littéraire de la Ville d'Ypres et de l'ancienne West-Flandre (*Historical, Archæological, and Literary Society of the City of Ypres and Old West Flanders*). [i]

DENMARK.

Aalborg.

1709. Samlinger til Jydsk Historie (*Society for the History of Jutland*).

Kjöbenhavn (*Copenhagen*).

1711. Botaniske Forening (*Botanical Society*). [i]

[Botanisk Tidsskrift (*Botanical Gazette*)—published by the Botanical Society.]

[Bulletin Météorologique du Nord (*Meteorological Bulletin of the North*)—published by the Danske Meteorologiske Institut.]

Kjöbenhavn (*Copenhagen*)—Continued.

1713. Comité du Laboratoire de Carlsberg (*Committee of the Carlsberg Laboratory*).

1715. Danske Meteorologiske Institut (*Danish Meteorological Institute*). [i]

1717. Den Danske Gradmaaling (*Danish Geodetic Commission*).

1719. Det Store Kongelige Bibliotheket (*Grand Royal Library*). [iii]

1721. Fængsels Tidende (*Prison Review*).

1723. Fiskeri Tidende (*Journal of Fisheries*) [formerly Nordisk Tidsskrift for Fiskeri]. [i]

1725. Foreningen til Fiskeries Fremme i Danmark og Bilande (*Society for the Improvement of the Fisheries of Denmark*).

1727. Geografiske Selskab (*Geographical Society*. [i]

[Greenlanders Home—now called Department of the Commerce of Greenland.]

1729. Department of the Commerce of Greenland [formerly Greenlanders Home].

1731. His Majesty the King of Denmark.

[Historisk Tidsskrift—published by the Historisk Selskab.]

1733. Historisk Selskab (*Historical Society*).

1735. Islandiske Litterœre Selskab (*Icelandic Literary Society*). [i]

1737. Kongelige Danske Selskab for Fædrelandets Historie og Sprog (*Royal Danish Society of the Natural History and Language*). [i]

1739. Kongelige Danske Videnskabernes Selskab (*Royal Danish Society of Sciences*). [iii]

1741. Kongelige Geheime Archivet (*Royal Court of Records*). [i]

1743. Kongelige Landhuusholdnings Selskab (*Royal Agricultural Society*). [i]

1745. Kongelige Mediciniske Selskab (*Royal Medical Society*). [i]

1747. Kongelige Museum for Nordiske Oldskrifters (*Royal Museum of Northern Antiquities*). [i]

1749. Kongelige Nordiske Oldskrift Selskab (*Royal Society of Northern Antiquaries*). [The scientific agent of the Kongelige Museum for Nordiske Oldskrifters]. [iii]

1751. Kongelige Statistiske Bureau (*Royal Statistical Bureau*). [i]

1753. Kongelige Veterinair og Landbo-Höiskole (*Royal Veterinary and Agricultural High School*). [i]

1755. Mathematiske Tidsskrift (*Mathematical Journal*).

1757. Minister för det Indre (*Minister of Interior*).

1759. Minister för Kirk og Underigs (*Minister of Church and Public Instruction*).

1761. National Oekonomiske Tidsskrift (*Journal of National Economy*).

1763. Naturhistoriske Forening (*Natural History Society*). [i]

Kjöbenhavn (*Copenhagen*)—Continued.

1765. Naturhistorisk Tidsskrift (*Journal of Natural History*). [i]

[Nordisk Tidsskrift för Fiskerie. (See Fiskerie Tidende).]

1767. Polytechniske Lære-Anstalt (*Polytechnic School*). [i]

[Samfundet til den Danske Literaturs Fremme (*Society for the Advancement of Danish Literature*). Extinct.]

1769. Sökaart Archivet (*Hydrographic Office*). [i]

1771. Tidsskrift for Philologi og Pædagogik (*Philological and Pædagogical Journal*). [i]

[Tidsskrift for populære Fremstillinger af Natur Videnskaberne (*Journal of Popular Natural Sciences*). Discontinued.]

1773. Tidsskrift for Veterinærer (*Veterinary Journal*). [i]

1775. Universitets Astronomiske Observatoriet (*University Astronomical Observatory*)—[does not publish anything]. [i]

1777. Universitets Bibliotheket (*University Library*). [i]

1779. Universitets Botaniske Have (*Botanical Garden of the University*). [i]

1781. Universitets Mineralogiske Museum (*Mineralogical Museum of the University*). [i]

1782. Universitets Zoologiske Museum (*Zoological Museum of the University*)—[does not publish anything].

[Veterinær Selskab (*Veterinary Society*). Dissolved.]

Odense.

1783. Danmarks Apotheker Forening (*Danish Apothecaries' Association*). [i]

1785. Samlinger til Fyens Historie (*Society for the History of Funen*).

FRANCE.

[Association Française pour l'Avancement des Sciences (*French Association for the Advancement of Sciences*). (See Paris).]

[Association Scientifique de France (*Scientific Association of France*). In La Sorbonne.] [i]

[Congrès Archéologique de France (*Archæological Congress of France*). In Tours.] [i]

[Institut des Provinces de France (*Institute of the Provinces of France*). Dissolved.]

Abbeville.

1787. Société d'Émulation (*Emulative Society*). [i]

1789. Société Linnéenne du Nord de la France (*Linnean Society of the North of France*).

Agen.

1791. Bibliothèque Communale (*Public Library*).

1793. Société d'Agriculture, Sciences, et Arts d'Agen (*Agen Society of Agriculture, Sciences, and Arts*). [i]

Aix (*Bouches du-Rhône*).

1795. Académie des Sciences, Agriculture, Arts, et Belles-Lettres (*Academy of Sciences, Agriculture, Arts, and Belles-Lettres*). [i]

1797. Revue Sextienne [Société des Gens de Lettres] ("*Review Sextienne";—of the Society of Literary Gentlemen*).

1799. Société Historique de Provence (*Historical Society of Provence*). [i]

Alais.

1801. Société Scientifique et Littéraire (*Scientific and Literary Society*). [i]

Albi.

1803. Société des Sciences, Belles-Lettres et Arts du Tarn (*Society of Sciences, Letters, and Arts, of Tarn*).

Alençon.

1805. Société Historique et Archéologique (*Historical and Archæological Society*).

Allier.

1807. Société des Sciences Médicales de Gannat (*Society of Medical Sciences of Gannat*).

Amiens.

1809. Académie des Sciences, Lettres, et Arts d'Amiens (*Academy of Sciences, Letters, and Arts*). [i]

1811. Bibliothèque Communale de la Ville d'Amiens (*Public City Library*). [i]

[Conférence Littéraire et Scientifique de Picardie (*Literary and Scientific Conference of Picardy*). Ceased to exist.]

1813. Société des Antiquaires de Picardie (*Society of Antiquarians of Picardy*). [i]

1815. Société d'Horticulture de Picardie (*Horticultural Society of Picardy*). [i]

1817. Société Industrielle d'Amiens (*Industrial Society of Amiens*). [i]

1819. Société Linnéenne du Nord de la France (*Linnean Society of the North of France*). [i]

Angers.

1821. Académie des Sciences et Belles-Lettres (*Academy of Sciences and Belles-Lettres*) [formerly Société Académique de Maine-et-Loire]. [iii]

1823. Comité Historique et Artistique de l'Ouest (*Historical and Artistic Committee of the West*). [i]

1825. Société Industrielle et Agricole (*Industrial and Agricultural Society*). [i]

Angers—Continued.

1827. Société d'Études Scientifiques (*Society of Scientific Studies*). [i]

1829. Société Linnéenne de Maine-et-Loire (*Linnean Society of Maine and Loire*). [i]

1831. Société d'Agriculture, Sciences et Arts (*Society of Agriculture, Sciences, and Arts*). [i]

Angoulême.

1833. Société d'Agriculture, Sciences, Arts et Commerce de la Charente (*Charente Society of Agriculture, Sciences, Arts, and Commerce*). [i]

1835. Société Archéologique et Historique de la Charente (*Archæological and Historical Society of Charente*). [i]

Annecy.

1837. Société Florimontane (*Florimontane Society*). [i]

1839. Revue Savoisienne (*Savoy Review*).

Apt.

1841. Société Littéraire, Scientifique et Artistique d'Apt (*Literary, Scientific, and Artistic Society of Art*). [i]

Argenton-sur-Creuse (*Indre*).

1843. Société Pharmaceutique du Département de l'Indre (*Pharmaceutical Society of the Department of Indre*). [i]

Arles (*Bouches-du-Rhône*).

1845. Commission Archéologique (*Archæological Commission*). [i]

Arras.

1847. Académie [des Sciences, Lettres et Arts] d'Arrras (*Arras Academy of Sciences, Letters, and Arts*). [i]

1849. Station d'Agriculture (*Agricultural Station*).

1851. Commission des Monuments Historiques et des Antiquités du Département de Pas-de-Calais (*Commission of Historical Monuments and Antiquities of the Department of Pas-de-Calais*). [i]

1853. École des Ingénieurs (*Engineer School*).

Auch.

1855. Société Française de Botanique (*French Botanical Society*).

1857. Société Historique de Gascogne (*Historical Society of Gascony*). [i]

Aurillac.

1859. Société Académique (*Academic Society*). [i]

Autun (*Saône-et-Loire*).

1861. Société Eduenne [des Lettres, Sciences et Arts] (*Eduenne Society;—of Letters, Sciences, and Arts*). [i]

Auxerre.

1863. Société des Sciences Historiques et Naturelles de l'Yonne (*Society of Historical and Natural Sciences, of Yonne*). [i]

1865. Société Médicale de l'Yonne (*Medical Society of Yonne*). [i]

1867. Société pour la Propagation de l'Instruction Populaire (*Society for the Promotion of Public Instruction*).

Avallon.

1869. Société d'Études d'Avallon (*Avallon Society of Studies*). [i]

Avesnes.

1871. Société Archéologique de l'Arrondissement d'Avesnes (*Archæological Society of the District of Avesnes*). [i]

Avignon.

1873. Musée Culvet de la Ville (*Culvet City Museum*). [i]

1875. Société Archéologique (*Archæological Society*). [i]

Avranches (*Manche*).

1877. Société d'Archéologie, Littérature, Sciences et Arts d'Avranches (*Society of Archæology, Literature, Sciences, and Arts, of Avranches*). [i]

Bagnères-de-Bigorre (*Hautes Pyrénées*).

1879. Observatoire du Pic du Midi (*Observatory of Pic du Midi*). [i]

1881. Société Ramond (*Ramond Society*). [i]

Bar-le-Duc.

1883. Société des Lettres, Sciences et Arts [de Bar-le-Duc] (*Society of Letters, Sciences, and Arts, of Bar-le-Duc*). [i]

1885. Société du Musée (*Society of the Museum*) [i]

Bastia.

1887. Société des Sciences Historiques et Naturelles de la Corse (*Society of Historical and Natural Sciences, of the Corse*).

Bayeux (*Calvados*).

1889. Société d'Agriculture, Sciences, Arts et Belles-Lettres (*Society of Agriculture, Sciences, Arts, and Belles-Lettres*).

Bayonne (*Basses-Pyrénées*).

1891. Société des Sciences et Arts (*Society of Sciences and Arts*). [i]

Beaune (*Côte-d'Or*).

1893. Société d'Archéologie, d'Histoire et de Littérature de l'Arrondissement de Beaune (*Society of Archæology, History, and Literature of the District of Beaune*). [i]

Beauvais.

1895. L'Athénée du Beauvaisis (*Athenæum of Beauvais*).

Beauvais—Continued.

1897. Comité Archéologique, ou Commission Archéologique du Diocèse de Beauvais (*Archæological Committee of the Diocese of Beauvais*).

1899. Société Académique d'Archéologie, Sciences et Arts, du Département de l'Oise (*Academic Society of Archæology, Sciences, and Arts of the Department of Oise*). [i]

1901. Société d'Horticulture et de Botanique de Beauvais (*Horticultural and Botanical Society of Beauvais*).

1903. Société Médicale et Pharmaceutique des Arrondissements de Beauvais et de Clermont (*Medical and Pharmaceutical Society of the Districts of Beauvais and Clermont*).

Belfort.

1905. Société Belfortaine d'Émulation (*Belfort Competitive Society*). [i]

Bergues (*Nord*).

1907. Société de l'Histoire et des Beaux Arts de la Flandre maritime (*Society of the History and Fine Arts of maritime Flanders*). [i]

Besançon.

1909. Académie des Sciences, Belles-Lettres et Arts (*Academy of Sciences, Belles-Lettres, and Arts*). [i]

1911. Société d'Émulation du Doubs (*Competitive Society of Doubs*). [i]

1913. Société des Amis des Beaux Arts (*Society of Friends of Fine Arts*).

Béziers (*Hérault*).

1915. Société Archéologique, Scientifique et Littéraire de Béziers (*Archæological, Scientific, and Literary Society of Béziers*). [i]

1917. Société d'Études des Sciences Naturelles de Béziers (*Béziers Society for the Study of Natural Sciences*). [i]

Blois.

1919. Société des Sciences et Lettres de Loir-et-Cher (*Society of Sciences and Letters, of Loir-et-Cher*). [i]

Bordeaux.

1921. Académie Ethnographique de la Gironde (*Ethnographic Academy of Gironde*). [i]

1923. Académie des Belles-Lettres, Sciences et Arts (*Academy of Belles-Lettres, Sciences, and Arts*). [iii]

[Association Bastiat. (See Société d'Economie Politique.)]

1925. Bibliothèque de la Ville (*City Library*). [i]

1927. Chambre de Commerce (*Chamber of Commerce*). [i]

1929. Commission des Monuments et Documents Historiques (*Commission of Historical Monuments and Documents*). [i]

Bordeaux—Continued.

1931. Conseil d'Hygiène Publique et de Salubrité du Département de la Gironde (*Public Health Council of the Department of Gironde*). [i]

1933. Faculté des Sciences (*Faculty of Sciences*).

[Institut Confucius de France. Discontinued.]

1935. Journal de Médecine de Bordeaux (*Medical Journal of Bordeaux*). [i]

1937. Muséum d'Histoire Naturelle (*Natural History Museum*). [i]

1939. Muséum Préhistorique de Bordeaux (*Prehistoric Museum of Bordeaux*). [i]

1941. Observatoire (*Observatory*). [i]

1943. Société d'Agriculture de la Gironde (*Agricultural Society*). [i]

1945. Société Archéologique de la Gironde (*Archæological Society of the Gironde*). [i]

1947. Société des Archives Historiques du Département de la Gironde (*Society of Historical Archives of the Department of the Gironde*). [i]

1949. Société Bibliographique; Comité de Bordeaux (*Bibliographical Society; Bordeaux Committee*).

1951. Société des Bibliophiles de Guyenne (*Society of Bibliophilists of Guyenne*). [i]

1953. Société d'Économie Politique (*Society of Political Economy*) [Association Bastiat].

1955. Société de Géographie Commerciale (*Society of Commercial Geography*). [i]

1957. Société d'Horticulture de la Gironde (*Horticultural Society of the Gironde*). [i]

1959. Société Humanitaire et Scientifique du Sud-Ouest de la France (*Humanitarian and Scientific Society of the Southwest of France*). [i]

1961. Société Linnéenne de Bordeaux (*Linnean Society of Bordeaux*). [iii]

1963. Société de Médecine de Bordeaux (*Medical Society of Bordeaux*). [i]

1965. Société de Médecine et de Chirurgie de Bordeaux (*Medical and Surgical Society of Bordeaux*). [i]

1967. Société Médico-Chirurgicale des Hôpitaux et Hospices de Bordeaux (*Medico-Surgical Society of Hospitals and Almshouses of Bordeaux*). [i]

1969. Société de Pharmacie (*Pharmaceutical Society*). [i]

1971. Société Philomathique de Bordeaux (*Philomathic Society of Bordeaux*).

1973. Société des Sciences Physiques et Naturelles (*Society of Physical and Natural Sciences*). [i]

Boulogne-sur-Mer (*Pas-de-Calais*).

1975. Société Académique (*Academic Society*). [i]

1977. Société d'Agriculture, Sciences et Arts de Boulogne-sur-Mer (*Society of Agriculture, Sciences, and Arts, of Boulogne-sur-Mer*). [i]

Bourg.

1979. Société d'Émulation, Agriculture, Sciences, Lettres et Arts de l'Ain (*Competitive Society of Agriculture, Sciences, Letters, and Arts, of Ain*). [i]

1981. Société de Géographie de l'Ain (*Geographical Society of Ain*).

1983. Société Littéraire, Historique et Archéologique du Département de l'Ain (*Literary, Historical, and Archæological Society of the Department of Ain*). [i]

Bourges.

1985. Société Historique, Littéraire, Artistique et Scientifique du Département du Cher (*Historical, Literary, Artistic, and Scientific Society of the Department of Ain*) [formerly Commission Historique du Cher]. [i]

1987. Société d'Agriculture du Département de Cher (*Agricultural Society of the Department of Cher*). [i]

1989. Société des Antiquaires du Centre (*Central Society of Antiquarians*).

Brest (*Finistère*).

1991. Bibliothèque de la Marine Nationale (*Library of the National Navy*). [i]

1993. Observatoire (*Observatory*).

1995. Société Académique de Brest (*Academic Society of Brest*). [i]

1997. Société d'Agriculture de Brest (*Agricultural Society of Brest*). [i]

Briey.

[Société Archéologique et Historique (*Archæological and Historical Society*). Has been transferred to Metz, Alsace-Lorraine, Germany.]

Caen.

1999. Académie Nationale des Sciences, Arts et Belles-Lettres (*National Academy of Sciences, Arts, and Belles-Lettres*). [iii]

2001. Association d'Agriculture et d'Horticulture des Instituts de la Zone Campandri-Valcongrain (*Agricultural and Horticultural Association of the Institutes of the Campandri-Valcongrain*). [i]

2003. Association Normande pour les Progrès de l'Agriculture, de l'Industrie et des Arts (*Normandy Association for the Advancement of Agriculture, Industry, and Arts*). [i]

2005. Musée d'Histoire Naturelle (*Natural History Museum*). [i]

Caen—Continued.

2007. Société Centrale d'Horticulture (*Central Horticultural Society*).

2009. Société d'Agriculture et de Commerce de Caen (*Society of Agriculture and Commerce of Caen*). [i]

2011. Société des Antiquaires de Normandie (*Society of Antiquaries of Normandy*). [iii]

2013. Société des Beaux Arts (*Society of Fine Arts*). [i]

[Société Française d'Archéologie pour la Conservation et la Description des Monuments Historiques (*French Society of Archæology for the Preservation and Description of Historical Monuments*). (See Tours).]

2015. Société Linnéenne de Normandie (*Linnean Society of Normandy*). [iii]

2017. Société de Médecine de Caen et du Calvados (*Medical Society of Caen and Calvados*). [i]

2019. Société Philomathique du Calvados (*Philomathic Society of Calvados*).

Cahors.

2021. Société des Études Littéraires, Scientifiques et Artistiques du Lot (*Society of Literary, Scientific, and Artistic Studies of Lot*). [i]

Cambrai (*Nord*).

2023. Société d'Émulation (*Competitive Society*). [i]

Cannes.

[Société des Sciences Naturelles, des Lettres et des Beaux Arts de Cannes et de l'Arrondissement de Grasse (*Society of Natural Sciences, Letters, and Fine Arts of Cannes and the District of Grasse*). Dissolved.]

Carcassonne.

2025. Société des Arts et Sciences (*Society of Arts and Sciences*). [i]

Castres.

2027. Commission des Antiquités de la Ville de Castres et du Département du Tarn (*Antiquarian Commission of Castres and of the Department of Tarn*). [i]

[Société scientifique et littéraire de Castres réunie à la Commission des Antiquités de la Ville de Castres (*Scientific and Literary Society of Castres, united with the Antiquarian Commission of the city of Castres*).]

Châlons-sur-Marne.

2029. Société d'Agriculture, Commerce, Sciences et Arts du Département de la Marne (*Society of Agriculture, Commerce, Sciences, and Arts of Marne*). [iii]

Châlon-sur-Saône.

["Egyptiologie." Discontinued.]

2031. Société d'Histoire et d'Archéologie de Châlon (*Archæological and Historical Society of Chalon*). [i]

2033. Société des Sciences Naturelles de Saône-et-Loire (*Society of Natural Sciences of Saône-et-Loire*). [i]

Chambéry.

2035. Académie des Sciences, Lettres et Arts de Savoie (*Academy of Sciences, Letters, and Arts of Savoy*). [i]

2037. Société d'Histoire Naturelle de Savoie (*Natural History Society of Savoy*).

2039. Société Médicale (*Medical Society*). [i]

2041. Société Savoisienne d'Histoire et d'Archéologie (*Society of History and Archæology of Savoy*). [i]

Chartres.

2043. Société Archéologique d'Eure-et-Loir (*Archæological Society of Eure-and-Loire*). [i]

2045. Société d'Horticulture et de Viticulture d'Eure-et-Loir (*Society of Horticulture and Vine-culture, of Eure-et-Loir*). [i]

Châteaudun.

2047. Société Dunoise [Archéologie, Histoire, Sciences et Arts] (*Dunoise Society*). [i]

Châteauroux.

2049. Société d'Agriculture de l'Indre (*Agricultural Society of Indre*). [i]

Château-Thierry (*Aisne*).

2051. Société Historique et Archéologique de Chateau-Thierry (*Historical and Archæological Society of Chateau-Thierry*). [i].

Chauny (*Aisne*).

2053. Société de Pomologie et d'Arboriculture de Chauny (*Pomological and Arboricultural Society of Chauny*). [i]

2055. Société Régionale d'Horticulture dont Chauny est le Centre (*Horticultural Society of the Chauny Region*). [i]

Cherbourg (*Manche*).

2057. Société Académique de Cherbourg (*Academic Society of Cherbourg*). [iii]

2059. Société Nationale des Sciences Naturelles de Cherbourg (*National Society of Natural Sciences of Cherbourg*). [iii]

Clamecy.

2061. Société Scientifique et Artistique (*Scientific and Artistic Society*). [i]

Clermont-Ferrand.

2063. Académie des Sciences, Belles-Lettres et Arts (*Academy of Sciences, Belles-Lettres, and Arts*). [i]

2065. Société des Amis des Arts de l'Auvergne (*Auvergne Society of the Friends of Arts*). [i]

2067. Université de France—Faculté des Lettres (*University of France—Faculty of Letters*).

Clermont (*Oise*).

2069. Société d'Agriculture de Clermont-Oise (*Agricultural Society of Clermont*). [i]

2071. Société d'Horticulture de Clermont-Oise (*Horticultural Society of Clermont*). [i]

[Société des Amis des Arts de l'Auvergne (*Auvergne Society of the Friends of Arts*). (See Clermont-Ferrand.)]

Compiègne (*Oise*).

[Musée Kohmer (*Kohmer Museum*). Transferred to the Museum Trocadero, Paris.]

2073. Société Historique de Compiègne (*Historical Society of Compiègne*). [i]

Coulommiers (*Seine-et-Marne*).

2075. Société d'Horticulture de l'Arrondissement de Coulommiers (*Horticultural Society of the District of Coulommiers*). [i]

Coutances (*Manche*).

2077. Société Académique du Cotentin (*Academic Society of Cotentin*). [i]

Dax. (*Landes*).

2079. Société de Borda (*Borda Society*). [i]

Dijon.

2081. Académie des Sciences, Arts et Belles-Lettres de Dijon (*Academy of Sciences, Arts, and Belles-Letters of Dijon*). [iii]

2083. Bibliothèque de l'Université (*University Library*).

2085. Commission des Antiquités [Archéologique] de la Côte-d'Or (*Archæological Commission of Côte-d'Or*). [i]

2087. Journal d'Agriculture de la Côte-d'Or (*Agricultural Journal of Côte d'Or*). [i]

2089. Société d'Agriculture et d'Industrie Agricole du Département de la Côte-d'Or (*Society of Agriculture and FarmingIndustry of Côte-d'Or*). [i]

2091. Société d'Horticulture de la Côte-d'Or (*Horticultural Society of Côte-d'Or*). [i]

Douai. (*Nord*).

2093. Association Vétérinaire des Départements du Nord et du Pas-de-Calais (*Veterinary Association of the Departments of the North and Pas-de-Calais*). [i]
2095. Bibliothèque Municipale (*Municipal Library*).
2097. Musée d'Histoire Naturelle (*Natural History Museum*). [i]
2099. Société d'Agriculture, des Sciences et Arts, Central du Département du Nord (*Central Society of Agriculture, Sciences, and Arts of the Department of the North*). [iii]
2101. Union Géographique du Nord de la France (*Geographical Union of the North of France*). [i]

Draguignan.

2103. Société d'Agriculture, de Commerce et de l'Industrie du Département du Var (*Society of Agriculture, Commerce and Industry of the Department of Var*). [i]
2105. Société des Études Scientifiques et Archéologiques (*Society of Scientific and Archæological Studies*). [i]

Dunkerque. (*Nord*).

2107. Comité Flammand de France (*Flemish Committee of France*).
2109. Société Dunkerquoise pour l'Encouragement des Sciences, des Lettres et des Arts (*Dunkirk Society for the Promotion of Sciences, Letters, and Arts*). [i]

Écully.

2111. Institut d'Agriculture du Rhône (*Agricultural Institute of the Rhône*).

Elbeuf (*Seine-Inférieure*).

2113. Société d'Enseignement Mutuel des Sciences Naturelles (*Society for Mutual Instruction in Natural Sciences*).
2115. Société Industrielle d'Elbeuf (*Industrial Society of Elbeuf*). [i]

Épinal.

2117. Société d'Émulation du Département des Vosges (*Competitive Society of the Department of Vosges*). [i]
2119. Société de Géographie de l'Est (*Geographical Society of the East*).

Évreux.

2121. Société Libre d'Agriculture, Sciences, Arts et Belles-Lettres du Département de l'Eure (*Free Society of Agriculture, Sciences, Arts, and Belles-Lettres of Eure*). [i]

Flers.

2123. Société Industrielle de l'Orne (*Industrial Society of Orne*).

Fontenay-le-Comte (*Vendée*).

2125. Société d'Horticulture (*Horticultural Society*). [i]

Gannat (*Allier*).

2127. Société des Sciences Médicales de Gannat (*Society of Medical Sciences of Gannat*). [i]

Grenoble.

2129. Académie Delphinale (*Delphinal Academy*). [i]
2131. Société d'Agriculture et d'Horticulture de Grenoble (*Agricultural and Horticultural Society of Grenoble*). [i]
2133. Société de Médecine et de Pharmacie de l'Isère (*Medical and Pharmaceutical Society of Isère*). [i]
2135. Société de Statistique de l'Isère (*Society of Statistics of Isère*). [i]

Guéret.

2137. Société des Sciences Naturelles et Archéologiques de la Creuse (*Society of Natural and Archæological Sciences of Creuse*). [i]

La Flèche.

2139. Société des Sciences et Arts de la Flèche (*Society of Sciences and Arts of La Flèche*).

Langres (*Haute-Marne*).

2141. Société Historique et Archéologique (*Historical and Archæological Society*). [i]

Laon.

2143. Société Académique de Laon (*Academic Society of Laon*). [i]

the Vendée). [i]

La Rochelle.

2145. Académie des Belles-Lettres, Sciences et Arts de La Rochelle (*Academy of Belles-Letters, Sciences, and Arts of La Rochelle*).
2147. Société des Amis des Arts (*Society of the Friends of Arts*).

La Roche-sur-Yon.

2149. Société d'Émulation de la Vendée (*Competitive Society of*

Laval.

2150. Commission Historique et Archéologique de la Mayenne (*Historical and Archæological Commission of Mayenne*). [i]
2151. Musée d'Histoire Naturelle (*Natural History Museum*).
2153. Société de l'Industrie, Manufacture, Agriculture, Sciences et Arts de la Mayenne (*Mayenne Society of Industries, Manufactures, Agriculture, Sciences, and Arts*). [i]

Le Havre (*Seine-Inférieure*).

2155. Société de Géographie Commerciale du Havre (*Havre Society of Commercial Geography*).
2157. Société Géologique de Normandie (*Geological Society of Normandy*). [i]
2159. Société Nationale Havraise des Études Diverses (*Havre National Society of Various Studies*). [i]
2161. Société de Pharmacie du Havre (*Pharmaceutical Society of Havre*). [i]

Le Havre (*Seine-Inférieure*)—Continued.

2163. Société des Sciences, Arts, Agriculture, et Horticulture, du Havre (*Havre Society of Sciences, Arts, Agriculture, and Horticulture*). [i]

Le Mans.

2165. Société d'Agriculture, Sciences et Arts de la Sarthe (*Society of Agriculture, Sciences, and Arts of Sarthe*). [iii]

2167. Société Historique et Archéologique du Maine (*Historical and Archæological Society of Maine*). [i]

2169. Société d'Horticulture de la Sarthe (*Horticultural Society of Sarthe*).

2171. Société de Médecine du Département de la Sarthe (*Medical Society of the Department of Sarthe*). [i]

2173. Société du Matériel Agricole de la Sarthe (*Agricultural Society of Sarthe*).

Le Puy.

2175. Société d'Agriculture, Sciences Arts, et Commerce (*Society of Agriculture, Sciences, Arts, and Commerce*). [i]

Les Vans (*Ardèche*).

2177. Société Historique et Archéologique du Canton des Vans (*Historical and Archæological Society of the Canton of Vans*). [i]

Lille.

2179. Commission Historique du Département du Nord (*Historical Commission of the Department of the North*). [i]

2181. Comité Agricole du Nord (*Agricultural Committee of the North*).

2183. Conseil Central d'Hygiène et de Salubrité (*Central Council of Hygiene and Public Health*).

2185. Faculté de Médecine et de Pharmacie (*Faculty of Medicine and Pharmacy*).

2187. Institut Zoologique (*Zoological Institute*).

2189. Musée d'Histoire Naturelle (*Museum of Natural History*). [i]

2191. Société des Architectes du Département du Nord (*Society of Architects of the Department of the North*).

2193. Société Centrale de Médecine du Nord de la France (*Central Medical Society of the North of France*). [i]

2195. Société de Geographie (*Geographical Society*).

2197. Société Géologique du Nord (*Geological Society of the North*). [i]

2129. Société des Sciences, de l'Agriculture et des Arts (*Society of Sciences, Agriculture, and Arts*). [iii]

Limoges.

2201. Commission Météorologique de la Haute-Vienne (*Meteorological Commission of Haute-Vienne*). [i]

Limoges—Continued.

2203. Société Archéologique et Historique du Limousin (*Archæological and Historical Society of Limousin*). [i]

2205. Société de Médecine et de Pharmacie de la Haute-Vienne (*Medical and Pharmaceutical Society of Haute-Vienne*). [i]

2207. Société d'Agriculture des Sciences et Arts de la Haute-Vienne (*Society of Agriculture, Sciences, and Arts of Haute-Vienne*). [i]

Lisieux (*Calvados*).

2209. Société d'Agriculture du Centre de la Normandie (*Agricultural Society of Central Normandy*). [i]

2211. Société d'Horticulture et de Botanique du Centre de la Normandie (*Horticultural and Botanical Society of Central Normandy*). [i]

Lons-le-Saulnier.

2213. Société d'Émulation du Jura (*Competitive Society of the Jura*).

2215. Société Pomologique de France (*Pomological Society of France*). [i]

Lorient (*Morbihan*).

2217. Observatoire (*Observatory*).

2219. Société de Géographie Bretonne (*Bretonne Geographical Society*).

Lyon.

2221. Académie des Sciences, Belles-Lettres et Arts de Lyon) (*Lyons Academy of Sciences, Belles-Letters, and Arts*). [iii]

2223. Association Lyonnaise des Amis des Sciences Naturelles (*Lyons Association of the Friends of Natural Sciences*). [i]

2225. Association pour la Propagation de la Foi (*Association for the Propagation of the Faith*).

2227. Commission Hydrométrique de Lyon (*Hydrometric Commission of Lyons*). [i]

2229. Commission Météorologique du Rhône (*Meteorological Commission of the Rhone*). [i]

2231. Musée Guimet (*Guimet Museum*). [i]

2233. Musée d'Histoire Naturelle de Lyon (*Natural History Museum of Lyons*). [i]

2235. Observatoire (*Observatory*). [i]

2237. Société Académique d'Architecture de Lyon (*Lyons Academic Society of Architecture*). [i]

2239. Société d'Agriculture, Histoire Naturelle et Arts Utiles de Lyon (*Lyons Society of Agriculture, Natural History, and Useful Arts*). [iii]

2241. Société d'Anthropologie de Lyon (*Anthropological Society of Lyons.*)

Lyon—Continued.

2243. Société Botanique de Lyon (*Botanical Society of Lyons*). [i]
2245. Société d'Économie Politique (*Society of Political Economy*).
2247. Société d'Education de Lyon (*Educational Society of Lyons*).
2249. Société d'Enseignement Professionel du Rhône (*Society of Mechanical Drawing of the Rhone*). [i]
2251. Société des Amis des Arts (*Society of the Friends of Arts*).
2253. Société d'Études Scientifiques (*Society of Scientific Studies*). [i]
2255. Société de Géographie (*Geographical Society*). [i]
2257. Société d'Horticulture Prâtique du Rhône (*Society of Practical Horticulture of the Rhône*).
2259. Société Linnéenne de Lyon (*Linnean Society of Lyons*). [iii]
2261. Société Littéraire, Historique et Archéologique (*Literary, Historical, and Archæological Society*). [i]
2263. Société Nationale de Médecine de Lyon (*National Medical Society of Lyons*). [i]
2265. Société Pomologique de France (*Pomological Society of France*). [i]
2267. Société des Sciences Industrielles (*Society of Industrial Sciences*). [i]
2269. Société des Sciences Médicales de Lyon (*Lyons Society of Medical Sciences*). [i]
2271. Université (*University*).

Mâcon.

2273. Académie des Sciences, Arts, Belles-Lettres et Géographie (*Academy of Sciences, Arts, Belles-Lettres, and Geography*) [formerly Académie de Mâcon—Société des Arts, Belles-Lettres et Agriculture]. [i]

Magny-en-Vexin (*Seine-et-Oise*).

2275. Société d'Agriculture et d'Horticulture (*Agricultural and Horticultural Society*).

Maleux. (See *Morlaix.*)

Marseilles.

2277. Académie des Sciences, Lettres et Arts (*Academy of Sciences, Letters, and Arts*). [iii]
2279. Comité Médical des Bouches-du-Rhône (*Medical Committee of Bouches-du-Rhône*). [i]
2281. École des Beaux Arts et Bibliothèque de la Ville (*School of Fine Arts, and City Library*). [i]
2282. École de Plein Exercice de Médecine et Pharmacie (*School of the Whole Practice of Medicine and Pharmacy*).
2283. Muséum d'Histoire Naturelle (*Natural History Museum*).
2285. Observatoire (*Observatory*). [i]

Marseilles—Continued.

2287. Société d'Agriculture du Département des Bouches-du-Rhône (*Agricultural Society of the Department of Bouche-du-Rhône*). [i]

2289. Société des Amis des Arts (*Society of the Friends of Arts*).

[Société d'Émulation de la Provence (*Competitive Society of Provence*). Discontinued.]

[Société d'Étude des Sciences Naturelles (*Society for the Study of Natural Sciences*)—now called Société d'Horticulture et de Botanique.]

2291. Société de Géographie (*Geographical Society*). [i]

2293. Société d'Horticulture et de Botanique (*Society of Horticulture and Botany*) [formerly Société d'Étude des Sciences Naturelles]. [i]

2295. Société de Médecine (*Medical Society*). [i]

2297. Société Médico-Chirurgicale des Hôpitaux (*Medico-Chirurgical Society of the Hospitals*). [i]

2299. Société Scientifique Industrielle (*Society of Industrial Sciences*). [i]

2301. Société de Statistique de Marseille (*Statistical Society of Marseilles*). [i]

2303. Société pour la Vulgarisation des Plantes Exotiques (*Society for the Domestication of Exotic Plants*).

2305. Union des Arts (*Art Union*). [i]

Mayenne.

2307. Société d'Agriculture de l'Arrondissement de Mayenne (*Agricultural Society of the District of Mayenne*). [iii]

2309. Société d'Archéologie, Sciences, Arts et Belles-Lettres de la Mayenne (*Mayenne Society of Archæology, Sciences, Arts, and Belles-Lettres*). [i]

Meaux (*Seine-et-Marne*).

2311. Société d'Archéologie, Sciences, Lettres et Arts du Département de Seine-et-Marne (*Society of Archæology, Sciences, Letters, and Arts of the Department of Seine-et-Marne*). [i]

2313. Société d'Horticulture de l'Arrondissement de Meaux (*Horticultural Society of the District of Meaux*). [i]

Melun.

2315. Société d'Archéologie, Sciences, Lettres et Arts de Seine-et-Marne (*Society of Archæology, Sciences, Letters, and Arts, of Seine-et-Marne*). [i]

Mende.

2317. Société d'Agriculture, Industrie, Sciences et Arts du Département de la Lozère (*Society of Agriculture, Industry, Sciences, and Arts of the Department of Lozère*). [i]

Mettray (*Indre-et-Loire*).

2319. Direction de la Colonie Pénitentiaire (*Direction of the Penal Colony*). [i]

Meudon (*Seine et-Oise*).

2321. Observatoire d'Astronomie Physique de Paris (*Paris Observatory of Physical Astronomy*). [i]

Mirecourt (*Vosges*).

2323. Société Agricole, Horticole et Viticole de l'Arrondissement de Mirecourt (*Society of Agriculture, Horticulture, and Vine-Culture of the District of Mirecourt*). [i]

Montauban.

2325. Société Archéologique de Tarn-et-Garonne (*Archæological Society of Tarn-et-Garonne*). [i]
2327. Société des Sciences, Belles-Lettres et Arts du Départément de Tarn-et-Garonne (*Society of Sciences, Belles-Lettres, and Arts, of Tarn-et-Garonne*). [i]

Montbéliard (*Doubs*).

2329. Société d'Émulation (*Competitive Society*). [i]

Montbrison (*Loire*).

2331. La Diana; Société Historique et Archéologique du Forez (*The Diana; Archæological and Historical Society of Forez*). [i]

Montpellier.

2333. Académie de Montpellier—Faculté de Médecine (*Medical Faculty of the Academy of Montpellier*). [iii]
2335. Académie des Sciences et Lettres de Montpellier (*Academy of Sciences and Letters of Montpellier*). [iii]
2337. Bibliothèque Universitaire—Section de Médecine (*University Library—Medical Section*).
2339. École Supérieure de Pharmacie (*College of Pharmacy*).
2341. Messager Agricole (*Agricultural Herald*). [i]
2343. Montpellier Médical (*Medical Journal*). [i]
2345. Revue des Sciences Naturelles (*Review of Natural Sciences*).
2347. Société Archéologique de Montpellier (*Archæological Society of Montpellier*). [iii]
2349. Société Centrale d'Agriculture du Département de l'Hérault (*Central Agricultural Society of the Department of Hérault*).
2351. Société de Géographie (*Geographical Society*). [i]
2353. Société d'Horticulture et d'Histoire Naturelle de l'Hérault (*Horticultural and Natural History Society of Herault*). [i]
2355. Société Languedocienne de Géographie (*Languedoc Geographical Society.*) [i]

Montpellier—Continued.

2357. Société pour l'Étude des Langues Romanes (*Society for the Study of Romance Languages*). [i]

2359. Société Séricicole de Montpellier (*Silk-Culture Society of Montpellier*). [i]

2361. Université (*University*).

Morlaix.

2363. Société des Études Scientifiques du Finistère (*Finistere Society of Scientific Study*).

Moulins.

2365. Société d'Émulation du Département de l'Allier (*Competitive Society of the Department of Allier*). [i]

2367. Société d'Horticulture de l'Allier (*Horticultural Society of Allier*). [i[

Moutiers (*Savoie*).

2369. Académie de la Val de l'Isère (*Academy of the Valley of the Isère*). [i]

Nancy.

2371. Académie de Stanislas (*Academy of Stanislas*). [iii]

2373. Bibliothèque Universitaire—Section de Médecine (*Medical Section, University Library*).

2375. École Forestière (*School of Forestry*).

2377. École de Médecine et de Pharmacie (*Medical and Pharmaceutical School*). [i]

2379. Faculté de Médecine (*Faculty of Medicine*).

2381. Société d'Archéologie Lorraine et Musée Historique Lorrain (*Society of Lorraine Archæology and Lorraine Historical Museum*).

2383. Société Centrale d'Agriculture (*Central Society of Agriculture*). [i]

2385. Société de Géographie de l'Est (*Geographical Society of the East*).

2387. Société de Médecine (*Medical Society*). [i]

2389. Société des Sciences de Nancy (*Society of Sciences, of Nancy*). [i]

Nantes.

2391. École de Plein Exercice de Médecine et Pharmacie (*School of the Whole Practice of Medicine and Pharmacy.*)

2393. Observatoire (*Observatory*).

2395. Société Académique de la Loire Inférieure (*Academic Society of Lower Loire*). [i]

2397. Société Archéologique de Nantes et de la Loire Inférieure (*Archæological Society of Nantes and of Lower Loire*). [i.]

2399. Société des Beaux Arts (*Society of Fine Arts*). [i]

Nantes—Continued.

2401. Société des Bibliophiles Bretons (*Society of Breton Bibliophiles*). [i]

2403. Société d'Histoire Naturelle (*Society of Natural History*). [i]

Narbonne (*Aude*).

2405. Commission Archéologique et Littéraire de l'Arrondissement de la Narbonne (*Archæological and Literary Commission of the District of Narbonne*). [i]

Nevers.

2407. Société Nivernaise des Lettres, Sciences et Arts (*Nevers Society of Letters, Sciences, and Arts*). [i]

Nice.

2409. Société Centrale d'Agriculture, d'Horticulture et d'Acclimatation (*Central Society of Agriculture, Horticulture, and Acclimation*). [i]

2411. Société des Architects des Alpes Maritimes (*Society of Architects, of the Maritime Alps*). [i]

2413. Société Niçoise des Sciences Naturelles et Historiques (*Nicene Society of Natural and Historical Sciences*).

2415. Société des Lettres, Sciences et Arts des Alpes Maritimes (*Society of Letters, Sciences, and Arts of the Maritime Alps*). [i]

Nîmes.

2417. Académie de Nîmes (*Academy of Nimes*). [iii]

2419. Société d'Études des Sciences Naturelles (*Society for the Study of Natural Sciences*). [i]

2421. Société d'Horticulture et de Botanique du Gard (*Horticultural and Botanical Society of Gard*). [i]

Niort.

[Société des Arts, Sciences et Belles-Lettres (*Society of Arts, Sciences, and Belles-Lettres*). Discontinued.]

2423. Société d'Horticulture, d'Arboriculture et de Viticulture des Deux-Sèvres (*Society of Horticulture, Arboriculture and Vine-Culture, of Deux-Sèvres*). [i]

2425. Société de Statistique, Sciences [Belles-Lettres] et Arts [du Département] des Deux-Sèvres (*Society of Statistics, Sciences, and Arts, of Deux-Sèvres.*) [i]

Noyon (*Oise*).

2427. Comité Historique et Archéologique de Noyon (*Historical and Archæological Committee of Noyon*). [i]

Orléans.

2429. Académie de Sainte-Croix (*Academy of the Holy Cross*). [i]

2431. Société d'Agriculture, Sciences, Belles-Lettres et Arts d'Orléans (*Orleans Society of Agriculture, Sciences, Belles-Lettres, and Arts*). [iii]

Orléans—Continued.

2433. Société Archéologique et Historique de l'Orléans (*Orleans Archæological and Historical Society*). [i]

2435. Société d'Horticulture d'Orléans (*Orleans Horticultural Society*). [i]

Paris.

["Abeille," Journal d'Entomologie (*The Bee, Entomological Journal*). (See "L'Abeille.")]

2439. Académie d'Aerostation Météorologique (*Academy of Meteorologic Aerostation*).

2441. Académie Nationale Agricole, Manufacturière et Commerciale (*National Academy of Agriculture, Manufactures, and Commerce*).

2443. Académie Nationale de Médecine (*National Academy of Medicine*). [i]

[Académie des Sciences (*Academy of Sciences*). (See Institut de France.)]

2445. "L'Aéronaute" (Aéronaute, 95 rue Lafayette).

2447. "Americana" (E. Dufossé, 27 rue Guénégand).

2449. Administration des Messageries Nationales—rue Notre Dame des Victoires 28 (*National Express Company*).

2451. American Exchange in Europe.

2453. Annales des Mines (*Annals of Mines*). [i]

2455. Annales de Physique et Chimie (*Annals of Physics and Chemistry*). [i]

2457. Annales des Ponts et Chaussées (*Annals of Civil Engineering*). [i]

[Administration des Lignes Télégraphiques. (See Ministère des Postes et Télégraphes.)]

2459. Annales des Sciences Géologiques (*Annals of Geological Sciences*). [i]

2461. Annales des Sciences Naturelles (*Annals of Natural Sciences*). [i]

2463. Archives Générales de Médecine (*General Records of Medicine*). [i]

2465. Archives de Médecine Navale (*Naval Medical Records*). [i]

2467. "Art Dentaire" (*Dental Journal*).

2469. Association pour l'Avancement des Sciences (*Association for the Advancement of Sciences*). [i]

2471. Association pour l'Encouragement des Études Grecques en France (*Association for the Promotion of Greek Studies in France*). [i]

[Athénée Oriental (*Oriental Athenæum*). (See L'Athénée).]

2473. Bibliothèque de la Ville (*City Library*). [Under the direction of the Préfecture de la Seine (No. 2637).] [iii]

Paris—Continued.

2475. Bibliothèque du Dépôt de l'État Major Général (*Library of the General Staff Depot* [formerly Dépôt des Cartes et Plans]. [iii]

2477. Bibliothèque Nationale (*National Library*). [iii]

2479. Bibliothèque Municipale du Seizième Arrondissement (*Public Library of the Sixteenth District*). [i]

2481. Bibliothèque Polonaise Historique Littéraire (*Library of Polish Historical Literature*). [i]

2483. "L. Bossange" (6 rue de Chabanais). [i]

2485. Bulletin du Canal Interocéanique (*Interoceanic Canal Journal*).

2487. Bulletin Hebdomadaire (*Weekly Journal*).

2489. Bulletin des Sciences Mathématiques et Astronomiques (*Bulletin of Mathematical and Astronomical Sciences*).

2491. Bulletin de la Société Chimique (*Bulletin of the Chemical Society*).

2493. Bureau Central Météorologique (*Central Meteorological Bureau*). [i]

2494. Bureau Français des Échanges Internationaux—au Ministère de l'Instruction Publique et des Beaux Arts (*French Bureau of International Exchanges, in the Department of Public Instruction and Fine Arts*). [i]

2495. Bureau d'Hydrographie (*Hydrographic Office*).

2497. Bureau de Statistique (*Statistical Bureau*).

2499. Bureau des Longitudes (*Bureau of Longitudes*). [i]

2501. Bureau International des Poids et Mêsures (*International Bureau of Weights and Measures*).

2503. Club Alpin Français (*French Alpine Club*). [i]

2505. Collège de France (*College of France*). [i]

2507. "Connaissance des Temps" [Bureau des Longitudes]. [i]

2509. "Comptes Rendus" (Quai des Augustins 25).

2511. Commission de la Carte Géologique de France (*Commission for the Geological Map of France*).

2513. Conservatoire des Arts et Métiers (*Conservatory of Arts and the Trades*). [i]

2514. Corps des Ponts et Chaussées (*Corps of Bridge and Road Engineers*) [Civil Engineers].

2515. "Cosmos" [incorporated in "Les Mondes"].

2516. [Depôt des Cartes et Plans de la Marine (*Depot of Charts and Designs of the Navy*).

2517. Dépôt de la Guerre (*Arsenal*) [au Ministère de Guerre]. [i]

[École d'Application d'État-Major (*Staff School*) in the École Militaire.]

2519. École Centrale des Arts et Manufactures (*Central School of Arts and Manufactures*). [i]

Paris—Continued.

2521. École de Médecine (*Medical School*).
2523. École Nationale de Dessins et de Mathématiques pour l'application des beaux arts à l'industrie (*National School of Design and Mathematics*).
2525. École des Hautes Études (*School of advanced studies*).
2527. École Nationale des Mines (*National School of Mines*). [iii]
2529. École Nationale et Spéciale des Langues Orientales Vivantes (*National Special School of Living Oriental Languages*). [i]
2531. École Polytechnique (*Polytechnic School*). [i]
2533. École des Ponts et Chaussées (*School of Civil Engineering*). [i]
2535. École Spéciale d'Architecture (*Special Architectural School*). [i]
2537. École Supérieure de Guerre (*Military School*). [i]
2539. "Feuilles des Jeunes Naturalistes" (*Journal of Young Naturalists*). [i]
2541. Gazette des Hôpitaux (*Hospital Gazette*). [i]
2543. Gazette Hebdomadaire (*Semi-weekly Gazette*). [i]
2545. Gazette Médicale de Paris (*Medical Gazette of Paris*). [i]

["Gervais Journal de Zoologie." Ceased to exist.]

2547. Institut Agronomique (*Agricultural Institute*). [i]
2549. Institut de France (*Institute of France*). [iii]
  2549*a*. Académie Française.
  2549*b*. Académie des Inscriptions et Belles-Lettres.
  2549*c*. Académie des Sciences. [i]
  2549*d*. Académie des Beaux Arts.
  2549*e*. Académie des Sciences Morales et Politiques.
2551. Institution Ethnographique (*Ethnographical Institute*). [i]
2553. Jardin des Plantes, Bibliothèque (*Library of the Botanical Garden*). [iii]
2555. "Investigateur."
2557. "Journal Asiatique" (28 rue de Bonaparte).
2559. "Journal d'Agriculture Pratique" (*Journal of Practical Agriculture*). [i]
2561. "Journal de Conchyliologie" (*Journal of Conchology*). [i]
2563. "Journal des Connaissances Médicales Pratiques et de Pharmacologie" (*Journal of Practical Medicine and Pharmacology*). [i]
2565. "Journal des Chemins de Fer et des Travaux Publics" (*Railroad and Public Works Journal*).

["Journal d'Hygiène" (*Journal of Hygiene*). (See Société Française d'Hygiène et Journal d'Hygiène.)]

2567. "Journal Général de l'Instruction Publique" (*Journal of Public Instruction*).

Paris—Continued.

2569. "Journal de Médecine et de Chirurgie Pratique" (*Journal of Practical Medicine and Surgery*). [i]
2571. "Journal de Mathématiques (*Journal of Mathematics*).
["Journal de Microscopie." Extinct.]
2573. "Journal de Physique" (*Journal of Physics*).
2575. "Journal des Savants" (*Journal of Scientists*). [i]
2577. "L'Abeille," Journal d'Entomology (*The Bee, Entomological Journal*). [i]
2579. "L'Athénée Oriental" (*Oriental Athenæum*). [i]
2581. "L'Année Scientifique et Littéraire" (*Scientific and Literary Annual*).
2583. "L'Exploration" (M. Jardin, 6 rue de Cassette).
["L'Institut, Journal Universelle." Ceased to exist.]
2585. "La Chasse Illustrée" (56 rue Jacob). [i]
2587. "La Lumière Électrique."
2589. "La Nature" (120 Boulevard St.-Germain). [i]
2591. "Le Bâtiment."
2593. "Le Muséon," Revue Internationale.
2595. "Le Moniteur Scientifique."
2597. "Le Temps" (10 rue du Faubourg Montmartre).
2599. "Les Mondes." ["Cosmos" has been united with it.] [i]
2601. "L'Union Médicale" (*Medical Union*).
2603. "Magasin Pittoresque," 29 Quai des Grands Augustins (*Picturesque Magazine*).
2605. Ministère de l'Agriculture (*Department of Agriculture*). [i]
2607. Ministère des Finances (*Finance Department*).
2609. Ministère des Affaires Étrangères (*Foreign Office*). [i]
2611. Ministère de la Guerre (*War Department*). [iii]
2613. Ministère de l'Intérieur (*Interior Department*).
2615. Ministère de l'Instruction Publique et des Beaux Arts (*Department of Public Instruction and the Fine Arts*). [iii]
2617. Ministère de la Marine et des Colonies (*Department of Marine and the Colonies*). [iii]
2619. Ministère des Postes et Télégraphes (*Department of Posts and Telegraphs*). [i]
2621. Ministère des Travaux Publics (*Department of Public Works*). [i]
2623. Ministère du Commerce (*Department of Commerce*).
2625. Musée d'Ethnographie [Trocadêro] (*Trocadero Museum of Ethnography*).
2627. Musée d'Histoire Naturelle (*Natural History Museum*). [i]
2629. Musée du Louvre (*Louvre Museum*).
2631. Musée Dupuytren [à l'Ècole de Médecine] (*Dupuytren Museum*).
2633. Observatoire National (*National Observatory*). [iii]

Paris—Continued.

2635. Observatoire Météorologique de Montsouris (*Central Meteorological Museum of Montsouris*). [i]

[Petites Nouvelles Entomologiques. Ceased to exist.]

2637. Préfecture de la Seine, Second Bureau du Cabinet (*Second Bureau of the Cabinet of the Prefecture of the Seine*).

2639. "Progrès Médical" (*Medical Progress*).

2641. Répertoire de Pharmacie (*Pharmaceutical Repertory*). [i]

2643. Revue d'Anthropologie, [120 Boulevard St.-Germain] (*Anthropological Review*). [i]

2645. "Revue Américaine" (*American Review*).

2647. Revue Archéologique (*Archæological Review*).

2649. Revue Botanique, [8 place de l'Odéon] (*Botanical Review*).

2651. Revue d'Ethnographie, [26 rue de Lubeck] (*Ethnographic Review*).

2653. Revue de Géographie, [55 rue des Feuillantines] (*Geographical Review*).

2655. Revue Géographique Internationale, [76 rue de la Pompe] (*International Geographical Review*). [i]

2657. Revue Horticole, [56 rue Jacob] (*Horticultural Review*).

2659. Revue Industrielle (*Industrial Review*). [i]

[Revue des Cours Littéraires. Discontinued.]

[Revue des Cours Scientifiques. Discontinued.]

2660. Revue des Deux Mondes. [Discontinued.]

[Revue de Géologie. Discontinued.]

2661. Revue de Linguistique et de Philologie Comparée (*Review of Linguistics and Comparative Philology*).

2663. Revue de Linguistique (*Review of Linguistics*).

2665. Revue Maritime et Coloniale (*Shipping and Colonial Review*). [i]

[Revue et Magasin de Zoologie. Discontinued.]

2667. Revue de Philologie (*Philological Review*).

2669. Revue Politique et Littéraire, [111 Boulevard St.-Germain] (*Political and Literary Review*).

2671. Revue Scientifique, [111 Boulevard St.-Germain] (*Scientific Review*). [i]

[Revue de Séricículture comparée. Discontinued.]

2673. Service Géographique au Ministère de la Guerre (*Geographical Bureau—War Department*).

2675. "Science et Nature," [19 rue Hautefeuille] (*Science and Nature*).

2677. Société d'Acclimatation, 11 rue de Lille (*Acclimatization Society*). [i]

[Société Académique Indo-Chinoise, etc. (See Neuilly.)]

2679. Société des Agriculteurs de France, [1 rue Lepelletier] (*Association of Agriculturists of France*). [i]

Paris—Continued.

[Société d'Agriculture. (See Société Centrale d'Apiculture).]

2681. Société Américaine de France, [12 rue Eblé] (*American Society of France*). [i]

2683. Société Anatomique, [15 rue de l'École de Médecine] (*Anatomical Society*). [i]

2685. Société d'Anthropologie, [15 rue de l'École de Médecine] (*Anthropological Society*). [i]

2687. Société Asiatique, [28 rue Bonaparte] (*Asiatic Society*). [i]

2689. Société de Biologie, [15 rue de l'École de Médecine] (*Biological Society*). [i]

2691. Société Botanique de France, [84 rue de Grenelle] (*Botanical Society of France*). [i]

2693. Société Centrale d'Apiculture et d'Insectologie (*Central Society of Bee-Culture and Entomology*). [i]

2695. Société Centrale des Architects, [168 Boulevard St.-Germain] (*Central Society of Architects*). [i]

2697. Société Centrale d'Éducation et d'Assistance pour les Sourds-Muets en France, [rue St.-Jacques 254] (*Central Society for the Education and Assistance of the Deaf and Dumb of France*). [i]

2699. Société Centrale Nationale d'Horticulture de Paris (*Central National Society of Horticulture of Paris*). [iii]

2701. Société Centrale de Médecine Vétérinaire, [19 rue de Lille] (*Central Veterinary Society*). [i]

2703. Société Chimique de Paris, [7 rue des Grands Augustins] (*Chemical Society of Paris*). [i]

2705. Société de Chirurgie de France (*Surgical Society of France*). [i]

[Société Cuviérienne. Dissolved.]

2707. Société de l'École des Chartes (*Society of the School of Charts*). [i]

2709. Société d'Encouragement pour l'Industrie Nationale (*Society for the Promotion of National Industry*). [iii]

2711. Société Entomologique de France, [à la Mairie du VI^e Arrondissement] (*Entomological Society of France*). [i]

2713. Société d'Ethnographie, [47 Avenue Duquesne] (*Ethnographical Society*). [i]

2715. Société d'Ethnologie (*Ethnological Society*). [i]

2717. Société des Études Historiques (*Society of Historical Studies*). [iii]

2719. Société des Études Japonaises, Chinoises, Tartares et Indo-Chinoises (*Society for Japanese, Chinese, Tartar, and Indo-Chinese Studies*). [i]

Paris—Continued.

2721. Société Française d'Archéologie et de Numismatique, [14 rue de Verneuil] (*French Society of Archæology and Numismatics*). [i]

2723. Société Française d'Hygiène, [30 rue du Dragon] (*French Society of Hygiene*). [i]

2725. Société Française de Navigation Aérienne, [7 rue des Grands Augustins] (*French Society of Aerial Navigation*). [i]

2727. Société Française de Statistique Universelle (*French Society of Universal Statistics*). [i]

2729. Société Franklin, [9 rue Christine] (*Franklin Society*). [i]

2731. Société de Géographie, [184 Boulevard St.-Germain] (*Geographical Society*). [iii]

2733. Société de Géographie Commerciale, [7 rue des Grands Augustins] (*Society of Commercial Geography*).

[Société de Géographie d'Oran. (See Oran, Africa.)]

2735. Société Géologique de France, [7 rue des Grands Augustins] (*Geological Society of France*). [iii]

2737. Société de l'Histoire de France (*Society of French History*). [i]

2739. Société de l'Histoire du Protestantisme Français, [17 place Vendôme] (*Society of the History of French Protestantism*). [i]

2741. Société des Ingénieurs Civils (*Society of Civil Engineers*). [i]

2743. Société de Législation Comparée, [44 rue de Rennes] (*Society of Comparative Legislation*). [i]

2745. Société de Linguistic de Paris, [63 Boulevard St.-Germain] (*Paris Society of Linguistics*). [i]

2747. Société Médicale Homœopathique, [31 rue Coquillière] (*Homœopathic Medical Society*). [i]

2749. Société Médicale des Hôpitaux de Paris (*Medical Society of the Hospitals of Paris*). [i]

2751. Société Médico-Légale de Paris, [7 rue Monsigny] (*Medico-Legal Society of Paris*). [i]

2753. Société de Médecine Pratique (*Society of Practical Medicine*).

2755. Société Météorologique de France, [7 rue des Grands Augustins] (*Meteorological Society of France*). [i]

2757. Société Minéralogique de France—à la Sarbonne (*Mineralogical Society of France*). [i]

2259. Société Nationale des Antiquaires de France—au Palais du Louvre (*National Society of Antiquaries of France*). [iii]

2761. Société Nationale d'Agriculture de France, [19 rue de Bellechasse] (*National Agricultural Society of France*). [iii]

2763. Société Nationale de Topographie Pratique (*National Society of Practical Topography*).

Paris—Continued.

[Société Nouvelle des Forges et Chantiers de la Méditerranée. (See Toulon.)]

2765. Société de Pharmacie (*Pharmaceutical Society*). [i]
2767. Société Philologique de Paris (*Philological Society of Paris*). [i]
2769. Société Philomathique, [7 rue des Grands Augustins] (*Philomathic Society*). [i]
2771. Société Polytechnique (*Polytechnic Society*). [i]
2773. Société Protectrice des Animaux, [19 rue de Lille] (*Society for the Protection of Animals*). [i]
2775. Société de Statistique de Paris (*Statistical Society of Paris*). [i]
2777. Société de Thérapeutique (*Therapeutical Society*). [i]
2779. Société de Topographie (*Topographical Society*).
2781. Société de Typographie (*Typographical Society*). [i]
2783. Société Zoologique de France (*Zoological Society of France*). [i]

Pau.

2785. Société des Sciences, Lettres, et Arts [de Pau] (*Society of Sciences, Letters, and Arts*). [i]

Périgueux.

2787. Société d'Agriculture, Sciences, et Arts de la Dordogne (*Society of Agriculture, Sciences, and Arts, of Dordogne*). [i]
2789. Société Historique et Archéologique du Périgord (*Historical and Archæological Society of Périgord*). [i]

Perpignan.

2791. Observatoire (*Observatory*).
2793. Société Agricole, Scientifique, et Littéraire des Pyrénées Orientales (*Agricultural, Scientific, and Literary Society of the Eastern Pyrenees*). [i]

Pic-du-Midi.

2795. Observatoire (*Observatory*).

Poitiers.

2797. Société d'Agriculture, Belles-Lettres, Sciences, et Arts (*Society of Agriculture, Belles-Lettres, Sciences, and Arts*). [i]
2799. Société des Antiquaires de l'Ouest (*Society of Antiquaries of the West*). [i]
2801. Société des Archives Historiques (*Society of Historical Records*). [i]
2803. Société de Médecine de Poitiers (*Medical Society of Poitiers*). [i]

Poligny (*Jura*).

2805. Société d'Agriculture, Sciences, et Arts de Poligny (*Society of Agriculture, Sciences, and Arts, of Poligny*). [i]

Pontoise.

2807. Société Historique et Archéologique de Pontoise et du Vexin (*Historical and Archæological Society of Pontoise and Vexin*).

Privas.

2809. Société des Sciences Historiques et Naturelles de l'Ardèche (*Society of Historical and Natural Sciences of Ardèche*). [i]

Puy-de-Dôme.

2811. Observatoire (*Observatory*).

Quimper.

2813. Société Archéologique du Finistère (*Archæological Society of Finistère*).

Rambouillet (*Seine-et-Oise*).

2815. Société Archéologique (*Archæological Society*). [i]

Reims (*Marne*).

2817. Académie Nationale de Reims (*National Academy of Reims*). [iii]
2819. Musée d'Histoire Naturelle de Reims (*Natural History Museum of Reims*). [i]
2821. Société Industrielle de Reims (*Industrial Society of Reims*). [i]
2823. Société Médicale (*Medical Society*). [i]
2825. Société des Sciences Naturelles (*Society of Natural Sciences*). [i]

Rennes.

2827. Bibliothèque de Rennes (*Library of Rennes*).
2829. Société Archéologique du Département d'Ille-et-Vilaine (*Archæological Society of the Department of Ille-et-Vilaine*). [i]

[Société des Sciences Physiques et Naturelles, etc. Dissolved.]

Riom (*Puy-de-Dôme*).

2831. Société du Musée [de Riom] (*Society of the Museum*). [i]

Rochefort (*Charente-Inférieure*).

2833. Observatoire (*Observatory*).
2835. Société d'Agriculture, des Belles-Lettres, Sciences, et Arts de Rochefort (*Rochefort Society of Agriculture, Belles-Lettres, Sciences, and Arts*). [i]
2837. Société de Géographie (*Geographical Society*). [i]

Rodez.

2839. Société des Lettres, Sciences, et Arts de l'Aveyron (*Aveyron Society of Letters, Sciences, and Arts*). [i]

Romans (*Drôme*).

2841. Bulletin d'Histoire Ecclésiastique et d'Archéologie Religieuse (*Bulletin of Ecclesiastical History and Biblical Archæology*). [i]

Roubaix (*Nord*).

2843. Société d'Émulation de Roubaix (*Competitive Society of Roubaix*). [i]

Rouen.

2845. Académie des Sciences, Belles-Lettres et Arts de Rouen (*Rouen Academy of Sciences, Belles-Lettres, and Arts*). [iii]
2847. Bibliothèque de la Ville (*City Library*). [i]
2849. Commission des Antiquités de la Seine-Inférieure (*Commission of Antiquities of Lower Seine*). [i]
2851. Société des Amis des Sciences Naturelles [de Rouen] (*Society of the Friends of Natural Sciences*). [i]
2853. Société des Bibliophiles Normandes (*Society of the Bibliophiles of Normandy*). [i]
2855. Société Centrale d'Horticulture de la Seine-Inférieure (*Central Horticultural Society of Lower Seine*). [i]
2857. Société d'Histoire de Normandie (*Historical Society of Normandy*). [i]
2859. Société Industrielle de Rouen (*Industrial Society of Rouen*). [i]
2861. Société Libre d'Émulation du Commerce et de l'Industrie de la Seine-Inférieure (*Free Competitive Society of Commerce and Manufactures of Lower Seine*). [i]
2863. Société de Médecine (*Medical Society*). [i]
2865. Société Normande de Géographie (*Normandy Geographical Society*). [i]

Royan-les-Bains.

2867. Académie des Muses Saintonges (*Saintonge Academy of the Muses*). [i]
2869. Société Linnéenne de la Charente-Inférieure (*Linnean Society of Lower Charente*). [i]

[Saint-Brienne. (See Saint-Brieuc.)]

Saint-Brieuc.

2871. Société Archéologique et Historique des Côtes-du-Nord (*Archæological and Historical Society of Côtes-du-Nord*). [i]
2873. Société d'Émulation des Côtes-du-Nord (*Competitive Society of Côtes-du-Nord*). [i]

Saint-Cyr (*Seine-et-Oise*).

2875. École des Affaires Militaires Spéciales (*School of Special Military Affairs*). [i]

Saint-Dié (*Vosges*).

2877. Société Philomatique Vosgienne (*Philomathic Society of Vosges*). [i]

Saint-Étienne.

2879. Société d'Agriculture, Industrie, Sciences, Arts et Belles-Lettres du Département de la Loire (*Society of Agriculture, Industry, Sciences, Arts, and Belles-Lettres of the Department of the Loire*). [i]

2881. Société de l'Industrie Minérale (*Society of Mineral Industry*). [i]

2883. Société de Médecine (*Medical Society*). [i]

Saint-Germain-en-Laye (*Seine-et-Oise*).

2885. Société d'Horticulture de Saint-Germain-en-Laye (*Horticultural Society of Saint-Germain-en-Laye*). [i]

Saint-Jean-d'Angely (*Charente-Inférieure*).

[Académie des Muses Santones. (See Royan-les-Bains.)]

2887 Société d'Agriculture de l'Arrondissement de Saint-Jean-d'Angely (*Agricultural Society of the District of Saint-Jean-d'Angely*).

2889. Société Historique et Scientifique (*Historical and Scientific Society*). [i]

[Société Linnéenne de la Charente-Inférieure. (See Royan-les-Bains.)]

Saint-Jean-de-Maurienne (*Savoie*).

2891. Société d'Historique et d'Archéologie de Maurienne (*Historical and Archæological Society of Maurienne*). [i]

Saint-Lô.

2893. Société d'Agriculture, d'Archéologie et d'Histoire Naturelle de la Manche (*La Manche Society of Agriculture, Archæology, and Natural History*). [i]

Saint-Maixent (*Deux-Sèvres*).

2895. Société de Statistique, Sciences et Arts des Deux-Sèvres (*Society of Statistics, Sciences, and Arts of Deux-Sèvres*). [i]

Saint-Martin-de-Hinx.

2897. Observatoire (*Observatory*).

Saint-Maur.

2899. Observatoire (*Observatory*).

Saint-Omer (*Pas-de-Calais*).

2901. Société des Antiquaires de la Morinie (*Antiquarian Society of Morinie*). [i]

Saint-Quentin (*Aisne*).

2903. Société Académique des Sciences, Arts, Belles-Lettres, Agriculture et Industrie (*Academic Society of Sciences, Arts, Belles-Lettres, Agriculture, and Industry*). [i]

2905. Société d'Horticulture de Saint-Quentin (*Horticultural Society of Saint-Quentin*). [i]

2907. Société Industrielle de Saint-Quentin et de l'Aisne (*Industrial Society of Saint-Quentin and of Aisne.* [i]

Saintes (*Charente-Inférieure*).

2909. Commission des Arts et des Monuments Historiques de la Charente-Inférieure (*Commission of Arts and Historical Monuments of the Lower Charente*). [i]

2911. Société des Archives Historiques de la Saintonge et de l'Aunis (*Society of Historical Records of Saintonge and of Aunis*). [i]

[Société des Arts, Sciences et Belles-Lettres. Dissolved.]

Semur en Auxois (*Côte d'Or*).

2913. Société des Sciences Historiques et Naturelles de Semur (*Semur Society of Historical and Natural Sciences*). [i]

Senlis (*Oise*).

2915. Comité Archéologique de Senlis (*Archæological Committee of Senlis*). [i]

2917. Société d'Horticulture de l'Arrondissement de Senlis (*Horticultural Society of the District of Senlis*). [i]

Sens (*Yonne*).

2919. Société Archéologique (*Archæological Society*). [i]

Soissons (*Aisne*).

2921. Société Archéologique, Historique et Scientifique de Soissons (*Archæological, Historical, and Scientific Society of Soissons*). [i]

[Société des Sciences, Belles-Lettres, et Arts. Dissolved.]

Tarbes.

[Société Académique des Hautes-Pyrénées (*Academic Society of the Upper Pyrenees*). Dissolved.]

Toulon (*Var*).

2923. Société Académique du Var (*Academic Society of Var*). [i]

2925. Société Nouvelle des Forges et Chantiers de la Méditerranée (*New Society of Forges and Dockyards of the Mediterranean*). [i]

Toulouse.

2927. Académie des Jeux Floraux (*Academy of Floral Games*). [i]
2929. Académie de Législation (*Academy of Legislation*). [i]
2931. Académie des Sciences, Inscriptions et Belles-Lettres de Toulouse (*Toulouse Academy of Sciences, Inscriptions, and Belles-Lettres*). [iii]
2932. "Matériaux pour l'Histoire Primitive et Naturelle de l'Homme," (*Materials for the Primitive and Natural History of Man*). [i]
2933. Observatoire (*Observatory*). [i]
2935. Revue Médicale de Toulon (*Medical Review of Toulon*).
2937. Société Académique Hispano-Portuguaise (*Spanish-Portuguese Academic Society*). [i]
2939. Société d'Agriculture de la Haute-Garonne et de l'Ariège (*Agricultural Society of the Upper Garonne and the Ariège*). [i]
2941. Société Archéologique du Midi de la France (*Archæological Society of the South of France*). [i]
2943. Société de Geographie (*Geographical Society*).
2945. Société d'Histoire Naturelle de Toulouse (*Natural History Society of Toulouse*). [i]
2947. Société Nationale de Médecine, Chirurgie et Pharmacie de Toulouse (*National Society of Medicine, Surgery, and Pharmacy of Toulouse*). [i]
2949. Société des Sciences Physiques et Naturelles (*Society of Physical and Natural Sciences*). [i]

Tours.

2951. Congrès Archéologique de France (*Archæological Congress of France*).
2953. Société d'Agriculture, Sciences, Arts et Belles-Lettres (*Society of Agriculture, Sciences, Arts, and Belles-Lettres*). [iii]
2955. Société Archéologique de Touraine (*Archæological Society of Touraine*). [i]
2957. Société Française d'Archéologie pour la Conservation et la Description des Monuments Historiques (*French Archæological Society for the Preservation and Description of Historical Monuments*). [i]
2959. Société de Géographie (*Geographical Society*).

Troyes.

2961. Société Académique d'Agriculture, Sciences, Arts et Belles-Lettres de l'Aube (*Academic Society of Agriculture, Sciences, Arts, and Belles-Lettres*). [i]
2963. Société Horticole, Vigneronne et Forestière de Troye (*Horticultural, Vine-Culture, and Forestry Society of Troyes*).

Tulle.

2965. Société des Lettres, Sciences et Arts de la Corrèze (*Corrèze Society of Letters, Sciences, and Arts*).

Valence.

2967. Société Départementale d'Agriculture de la Drôme (*Departmental Society of Agriculture of the Drome*). [i]

2969. Société Départementale d'Archéologie et de Statistique de la Drôme (*Departmental Society of Archæology and Statistics of the Drome*). [i]

Valenciennes (*Nord*).

2971. Société d'Agriculture, Sciences et Arts de l'Arrondissement de Valenciennes (*Society of Agriculture, Sciences, and Arts of the District of Valenciennes*). [i]

2973. Revue Agricole, Industrielle, Littéraire, et Artistique (*Agricultural, Industrial, Literary, and Artistic Review*).

Vannes.

2975. Société Polymathique du Morbihan (*Polymathic Society of Morbihan*). [i]

Vendôme (*Loire-et-Cher*).

2977. Société Archéologique, Scientifique, et Littéraire du Vendômois (*Archæological, Scientific, and Literary Society of Vendôme*). [i]

Verdun (*Meuse*).

2979. Société Philomatique (*Philomathic Society*). [i]

Versailles.

2981. Commission des Antiquités de Seine-et-Oise (*Archæological Commission of Seine-et-Oise*).

2983. Société d'Agriculture et des Arts [de Seine-et-Oise] (*Society of Agriculture and Arts*). [i]

2985. Société des Amis des Arts (*Society of the Friends of Arts*).

2987. Société d'Horticulture du Département de Seine-et-Oise (*Horticultural Society of Seine-et-Oise*). [i]

2989. Société des Sciences Morales, des Lettres et des Arts de Seine-et-Oise (*Society of Moral Sciences, Letters, and Arts of Seine-et-Oise*). [i]

2991. Société des Sciences Naturelles et Médicales de Seine-et-Oise (*Society of Natural and Medical Sciences of Seine-et-Oise*). [i]

Vesoul.

2993. Commission Archéologique de la Haute-Saône (*Archæological Commission of the Upper Saône*). [i]

2995. Société d'Agriculture, Sciences et Arts de la Haute Saône (*Society of Agriculture, Sciences, and Arts of the Upper Saône*). [i]

Vire.

[Société Viroise d'Émulation pour le Développement des Belles-Lettres, Sciences, Arts et de l'Industrie. Dissolved.]

Vitry-le-François (*Marne*).

2997. Société des Sciences et Arts de Vitry-le-François (*Society of Sciences and Arts of Vitry le François*). [i]

GERMANY.

[Allgemeiner Deutscher Apotheker-Verein (*General German Apothecaries' Association*). (See Halle.)

2999. Blinden Lehrer-Congress (*Congress of Teachers of the Blind*).

3001. Verein der Süd-Deutschen Forstwirthe (*Association of South German Forest Culturists*). [i]

3003. Versammlung Deutscher Land- und Forstwirthe (*Assembly of German Agriculturists and Forest Culturists*). [i]

3005. Versammlung Deutscher Naturforscher und Aerzte (*Assembly of German Naturalists and Physicians*). [i]

Aachen (*Prussia*).

3007. Königliches Polytechnikum (*Royal Polytechnicum*). [Formerly Royal Westphalian Polytechnical High School.] [i]

3009. Stadt-Bibliothek (*City Library*). [i]

Altenburg (*Prussia*).

3011. Gesammt-Verein der Deutschen Geschichts- und Alterthums-Vereine (*Central Union of the German Associations of History and Archæology*). [i]

Altena.

3013. Verein für Orts- und Heimath-Kunde im Süderlande (*Geographical Society of Suderland*).

Altenberg (*Saxe-Weimar*).

3015. Geschichts und Alterthumsforschende Gesellschaft des Osterlandes (*Society for Historical and Archæological Research of Osterland*). [i]

3017. Bienenwirthschaftlicher Verein (*Society for Bee-Culture*).

3019. Naturforschende Gesellschaft des Osterlandes (*Natural History Society of Osterland*). [iii]

3021. Pomologische Gesellschaft (*Pomological Society*). [i]

Altona (*Prussia*).

3023. Statistisches Bureau der Stadt Altona (*Statistical Bureau of the City of Altona*). [i]

3025. Thierschutz-Verein (*Society for the Protection of Animals*). [i]

Annaberg (*Saxony*).
3027. Annaberg-Buchholzer-Verein für Naturkunde (*Annaberg-Buchholz Association of Natural History*). [i]

Ansbach (*Bavaria*).
3029. Historischer Verein in Mittelfranken (*Historical Society of Central Franconia*). [i]

Arnsberg (*Prussia*).
3031. Historischer Verein für das Herzogthum Westfalen (*Historical Society of the Duchy of Westfalen*).
3033. Landes-Kultur-Gesellschaft für den Regierungsbezirk Arnsberg (*Agricultural Society of the District of Arnsberg*). [i]

Arnstadt (*Schwarzburg-Sondershausen*).
3035. Fürstliches Gymnasium (*Gymnasium*). [i]

Arolsen (*Waldeck*).
3037. Landes-Director der Fürstenthümer Waldeck und Pyrmont (*Government of the Principalities of Waldeck and Pyrmont*).
3039. Landwirthschaftlicher Verein im Fürstenthum Waldeck (*Agricultural Society of the Principality of Waldeck*). [i]

Aschaffenburg (*Bavaria*).
3041. Königliche Forst-Akademie (*Royal Forestry Academy*).

Augsburg (*Bavaria*).
3043. Deutscher Apotheker-Verein (*Society of German Apothecaries*). [i]
3045. Historischer Verein von Schwaben und Neuburg (*Historical Society of Suabia and Neuburg*). [i]
3047. Landwirthschaftlicher Verein für Schwaben und Neuburg (*Agricultural Society of Suabia and Neuburg*). [i]
3049. Naturhistorischer Verein (*Natural History Society*). [i]
3051. Wochenschrift für Thierheilkunde und Viehzucht (*Weekly Journal of Veterinary Medicine and Live-Stock Breeding*). [i]

Bamberg (*Bavaria*).
3053. Gewerbe-Verein (*Traders' Union*). [i]
3055. Königliche Bibliothek (*Royal Library*). [i]
3057. Historischer Verein zu Bamberg (*Historical Society of Bamberg*).
3059. Naturforschende Gesellschaft (*Natural History Society*). [iii]

Bautzen (*Saxony*).
3061. "Maćica Serbska."

Bayreuth (*Bavaria*).

3063. Historischer Verein für Oberfranken (*Historical Society of Upper Franconia*). [i]
3065. Polytechnische Gesellschaft (*Polytechnical Society*). [i]

Bendorf [*bei Koblenz*] (*Prussia*).

3067. Deutsche Gesellschaft für Psychiatrie und Gerichtliche Psychologie (*German Society of Psychiatry and Criminal Psychology*). [i]

Berlin (*Prussia*).

3069. Seine Majestät der Kaiser von Deutschland, König von Preussen (*His Majesty the Emperor of Germany, King of Prussia*). [iii]
3071. Afrikanische Gesellschaft (*African Society*). [i]
3073. Akklimatisations-Verein (*Acclimatization Society*).
3075. Allgmeine Deutsche Ornithologische Gesellschaft (*General German Ornithological Society*).
3077. Anatomisch-Zootomische Sammlung der Universität (*Anatomical-Zootomical Museum of the University*).
3079. Archäologische Gesellschaft (*Archæological Society*).
3081. Architekten-Verein (*Architects' Association*). [i]
3083. Berliner Apotheker-Verein (*Berlin Druggists' Association*).
3085. Berliner Aquarium (*Berlin Aquarium*). [i]
3087. Berliner Entomologischer Verein (*Berlin Entomological Society*). (See also Deutscher Entomologischer Verein.)
3089. Berliner Fröbel-Verein (*Berlin Froebel Association*).
3091. Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte (*Berlin Society of Anthropology, Ethnology, and Primitive History*). [i]
3093. Berliner Gesellschaft für das Studium der Neueren Sprachen (*Berlin Society for the Study of Modern Languages*). [i]
3095. Berliner Medizinische Gesellschaft (*Berlin Medical Society*). [i]
3097. Berliner Gesellschaft für Deutsche Sprache (*Berlin Society of the German Language*).
3099. Berliner Militärärztliche Gesellschaft (*Berlin Society of Military Surgeons*).
3101. Berliner Verein Homöopatischer Aerzte (*Berlin Society of Homœopathic Physicians*).
3103. Berliner Zahnärztlicher Verein (*Berlin Dental Association*).
3105. Berliner Gesellschaft für Deutsche Sprache und Alterthumskunde (*Berlin Society of German Language and Antiquity*).
3107. Berlinischer Künstler-Verein (*Berlin Artists' Association*).
3109. Beuth-Schinckel Museum (*Beuth-Schinckel Museum*).

Berlin (*Prussia*)—Continued.

3111. Botanischer Verein der Provinz Brandenburg (*Botanical Society of the Province of Brandenburg*). [i]

3113. Botanisches Institut der Universität (*Botanical Institute of the University*).

3115. Botanisches Museum der Universität (*Botanical Museum of the University*).

3117. Central-Auschuss der Berliner Aerztlichen Bezirks-Vereine (*Central Direction of the District Medical Societies of Berlin*).

3119. Central-Bureau für den Weltverkehr.

[Central-Bureau für die Europäische Gradmessung. (See Königlich-Preussisches Geodätisches Institut.)]

3121. Central-Institut für Akklimatisation in Deutschland (*Central Institute of Acclimatization in Germany*).

3123. Central-Komité des Deutschen Vereins vom Rothen Kreuz (*Central Committee of the German Society of the Red Cross*). [i]

3125. Central-Direction der Monumenta Germaniæ (*Central Direction of the "Monuments of Germany"*).

3127. Central-Verein für Handels-Geographie und Förderung der Interessen Deutschlands im Auslande (*Central Association of Commercial Geography, &c.*).

3129. Central-Verein für das Wohl der arbeitenden Klassen (*Central Association for the Welfare of the Working Classes*). [i]

3131. Central-Verband der Kaufleute Deutschlands (*Central Union of the Merchants of Germany*).

3133. Charité Krankenhaus (*Charity Hospital*). [i]

3135. Chemisches Laboratorium der Universität (*Chemical Laboratory of the University*).

3137. Chirurgische Klinik der Universität (*Chirurgical Clinic of the University*).

3139. Christlich-Archäologische Kunst-Sammlung der Universität (*Christian Archæological Museum of the University*).

3141. "Cypria," Verein der Geflügelfreunde in Berlin (*"Cypria," Society of Poultry-Friends in Berlin*).

3143. Deutscher und Oesterreichischer Alpen-Verein—Section Berlin (*Berlin Section of the German and Austrian Alpine Club*).

3145. Deutsche Botanische Gesellschaft (*German Botanical Society*).

3147. Deutsche Chemische Gesellschaft (*German Chemical Society*). [i]

3149. Deutsche Entomologische Gesellschaft (*German Entomological Society*). (See also, Berliner Entomologische Gesellschaft.) [i]

Berlin (*Prussia*)—Continued.

3151. Deutsche Geologische Gesellschaft (*German Geological Society*). [iii]
3153. Deutsche Gesellschaft für Chirurgie (*German Chirurgical Society*).
3155. Deutsche Gesellschaft für Mechanik und Optik (*German Society of Mechanics and Optics*).
3157. Deutsche Gesellschaft für Oeffentliche Gesundheitspflege (*German Society of Public Hygiene*).
3159. Deutsche Gesellschaft zur Erforschung Aequatorial Afrika's (*German Society for the Exploration of Equatorial Africa*).
3161. Deutsche Gesellschaft zur Hebung des Flachsbaues (*German Society for the Culture of Flax*).
3163. Deutsche Ornithologische Gesellschaft (*German Ornithological Society*). [i]
3165. Deutsche Reichstags-Bibliothek (*Library of the German Parliament*). [i]
3167. Deutsche Shakespeare Gesellschaft (*German Shakespeare Society*). [i]
3169. Deutsche Schiller-Gesellschaft (*German Schiller Society*).

[Deutsche Viehzucht und Herdbuch-Gesellschaft (*German Society of Fancy Stock Breeders*). Dissolved January 1, 1885.]

3171. Deutsche Zoologische Gesellschaft (*German Zoological Society*). [i]
3173. Deutscher Akademischer Verein für harmonische Lebensweise (*German Vegetarian Society*).
3175. Deutscher Entomologischer Verein (*German Entomologists' Association*). (See, also, Deutsche Entomologische Gesellschaft; and Berliner Entomologischer Verein.) [i]
3177. Deutscher Fischerei-Verein (*German Fishery Association*). [i]
3179. Deutscher Handels-Verein (*German Commercial Association*).
3181. Deutscher Juristentag (*German Jurists' Association*).
3183. Deutscher Kolonial-Verein (*German Colonial Association*).
3185. Deutscher Landwirthschaftsrath (*German Agricultural Council*).
3187. Deutscher Verein für Medizinische Statistik (*German Society of Medical Statistics*).
3189. Deutscher Patent-Schutz-Verein (*German Association for the Protection of Patents*).
3191. Deutscher Verein für Vogelzucht und Akklimatisation ["Aegintha"] (*Society for the Culture and Acclimatization of Birds*).

[Deutsches-Gewerbe Museum. (See Kunst-Gewerbe Museum.)]

Berlin (*Prussia*)—Continued.

3195. Deutscher Verein zur Förderung von Luftschiffahrt (*German Society for the Promotion of Aerial Navigation*).

3196. Deutsches Schul-Museum (*German School Museum*).

3197. Elektrotechnischer Verein (*Electrotechnical Association*).

3199. Entomologischer Verein (*Entomologists' Association*). (See, also, Berliner Entomologischer Verein, Deutsche Entomologische Gesellschaft, and Deutscher Entomologischer Verein.)

[Europäische Gradmessung. (See Königlich-Preussisches Geodätisches Institut.)]

3201. Frauen-Klinik der Universität (*Female Clinic of the University*).

3203. Freihandels-Verein (*Free Trade Association*).

3205. Geburtshülfliche und Gynäkologische Klinik der Universität (*Obstetrical and Gynæcological Clinic of the University*).

[General Direction der Königlichen Museum. (See Königliche Preussische Museen.)]

3207. Gesellschaft der Charité Aerzte (*Society of the Physicians of the Charity Hospital*).

3209. Gesellschaft der Gartenfreunde Berlins (*Berlin Society of Friends of Horticulture*).

[Gesellschaft für das Studium der Neueren Sprachen. (See Berliner Gesellschaft, &c.)]

3211. Gesellschaft für Deutsche Philologie (*Society of German Philology*).

3213. Gesellschaft für Erdkunde (*Geographical Society*). [iii]

3215. Gesellschaft für Geburtshülfe und Gynäkologie (*Obstetrical and Gynæcological Society*).

3217. Gesellschaft für Heilkunde (*Surgical Society*).

3219. Gesellschaft für Mikroskopie (*Microscopical Society*).

3221. Gesellschaft für Verbreitung von Volksbbildung (*Society for the Promotion of Education among the People*). [i]

3223. Gesellschaft Naturforschender Freunde (*Society of Friends of Natural History*). [i]

3225. Gymnasiallehrer-und Realschullehrer-Verein (*Society of Teachers of Gymnasium and "Real" Schools*).

3227. "Herold," Verein für Siegel und Wappenkunde (*"Herold," Society of Heraldry*).

3229. Geographisch-Statistische Abtheilung des General-Stabs (*Geographic Statistical Divison of the General Staff of the Army*).

3231. Historische Gesellschaft (*Historical Society*).

3233. Historisches Museum [Hohenzollern Museum] für die Geschichte des Hauses Hohenzollern (*Hohenzollern Museum*).

Berlin (*Prussia*)—Continued.

3235. Hufeländische Medizinische Gesellschaft (*Hufeland Medical Society*).
3237. Horticultur-Gesellschaft [Dr. Koch] (*Horticultural Society*). [i]
3239. Juristen-Gesellschaft (*Jurists' Society*).
3241. Institut für Pathologische Anatomie [Universität] (*Institute of Pathological Anatomy*).
3243. Kaiserliche [Deutsche] Admiralitäts-Haupt-Bibliothek (*Library of the Imperial Navy*). [i]
3245. Kaiserliches [Deutsches] Admiralitäts-Hydrographisches Amt (*Hydrographic Office of the Imperial Navy*). [i]
3247. Kaiserliches [Deutsches] Auswärtiges Amt (*Imperial Foreign Office*).
3249. Kaiserliches [Deutsches] Bundes-Amt für das Heimathwesen (*Imperial Home Office*).
3251. Kaiserliches [Deutsches] Gesundheits-Amt (*Imperial Health Office*).
3253. Kaiserliche [Deutsche] Normal-Aichungs-Kommission (*Imperial Central Gauging Commission*).
3255. Kaiserliches [Deutsches] Ober-See-Amt (*Imperial Marine Court*).
3257. Kaiserliches [Deutsches] Patent-Amt (*Imperial Patent Office*). [i]
3259. Kaiserliches [Deutsches] Reichs-Amt des Innern (*Imperial Department of Interior*).
3261. Kaiserliche [Deutsche] Reichs-Druckerei (*Imperial Printing Office*).
3263. Kaiserliches [Deutsches] Reichs-Eisenbahn-Amt (*Imperial Railroad Department*).
3265. Kaiserliches [Deutsches] Reichs-Justiz-Amt (*Imperial Department of Justice*).
3267. Kaiserliches [Deutsches] Reichs-Post-Amt (*Imperial Post-Office Department*).

[Kaiserliche [Deutsche] Reichstags-Bibliothek. (See Deutsche Reichstags-Bibliothek).]

3269. Kaiserliches [Deutsches] Reichs-Schatz-Amt (*Imperial Treasury Department*).
3271. Kaiserliche [Deutsche] Reichs-Schul-Kommission (*Imperial School Commission*).
3273. Kaiserliches [Deutsches] Statistisches Amt (*Imperial Statistical Bureau*). [1]
3275. Kaiserliche [Deutsche] Technische Kommission für Seeschifffahrt (*Imperial Technical Commission of the Navy*).
3277. Klinik für Chirurgie [Universität] (*Chirurgical Clinic*).

Berlin (*Prussia*)—Continued.

3279. Klinik für Kinderkrankheiten [Universität] (*Clinic for Diseases of Children*).

3281. Klinik für Nerven und Psychische Krankheiten [Universität] (*Clinic for Nervous and Psychical Diseases*).

3283. Klinik für Syphilis und Hautkrankheiten [Universität] (*Clinic for Syphilis and Skin Diseases*).

3285. Klinik und Poliklinik für Augenkrankheiten [Universität] (*Clinic for Diseases of the Eye*).

3287. Klinik und Poliklinik für Ohrenkrankheiten [Universität] (*Clinic for Diseases of the Ear*).

3289. Königliches [Preussisches] Abgeordneten-Haus (*Royal House of Representatives*).

3291. Königliche [Preussische] Akademie des Bauwesens (*Royal Architectural Academy*). [i]

3293. Königliche [Preussische] Akademie der Künste (*Royal Academy of Arts*).

3295. Königliche [Preussische] Akademie der Wissenschaften (*Royal Academy of Sciences*). [iii]

3297. Königliche [Preussische] Artillerie-Prüfungs-Kommission (*Royal Commission for Testing of Ordnance*).

3299. Königliche [Preussische Oeffentliche] Bibliothek (*Royal Library*). [iii]

3301. Königliche [Preussische] Blinden-Anstalt (*Royal Institution for the Blind*). [i]

3303. Königlicher [Preussischer] Botanischer Garten (*Royal Botanical Garden*).

3305. Königliches [Preussisches] Finanz-Ministerium (*Royal Treasury Department*).

3307. Königliche [Preussische] Friedrichs Wilhelms Universität (*Royal Frederic William University*). [i]

3309. Königlicher [Preussischer] General-Stab der Armee (*Royal General Staff of the Army*). [i]

3311. Königliches [Preussisches] Geodätisches Institut [Central Bureau für die Europäische Gradmessung] (*Royal Geodetic Institut*) [*Central Bureau of the European Geodetic Commission*). [i]

3313. Königliche [Preussische] Geologische Landes-Anstalt und Berg-Akademie (*Royal Geological Institution and Mining Academy*). [iii[

3315. Königliches [Preussisches] Gesetz-Sammlungs-Amt (*Royal Office of Records*).

[Königliche [Preussische] Gewerbe-Akademie. See Königliche [Preussische] Technische Hochschule.)]

3317. Königliches [Preussisches] Herrenhaus (*Upper House of the Royal* [*Prussian*] *Diet*).

Berlin (*Prussia*)—Continued.

3319. Königliches [Preussisches] Justiz-Ministerium (*Royal Department of Justice*).

3321. Königliche [Preussische] Landes-Aufnahme im General-Stab der Armee (*Royal Topographical Survey—Royal Staff of the Army*).

3323. Königliches [Preussisches] Kriegs-Ministerium (*Royal War Department*). [i]

3325. Königliche [Preussische] Kriegs-Akademie (*Royal Military Academy*). [i]

3327. Königliches [Preussisches] Kunst-Gewerbe-Museum (*Royal Museum of Art Industry*). [i]

3329. Königliches [Preussisches] Landes-Oekonomie-Kollegium (*Royal National Agricultural College*).

3331. Königliche [Preussische] Landes-Vertheidigungs-Kommission (*Royal Commission for the National Defence*).

3333. Königliche [Preussische] Landwirthschaftliche Hochschule (*Royal Agricultural College*). [i]

3335. Königliche [Preussische] Mechanisch-Technische Versuchs-Anstalten (*Royal Institution for Mechanical and Technical Tests*).

3337. Königliches [Preussisches] Meteorologisches Institut (*Royal Meteorological Institute*). [i]

3339. Königliches [Preussisches] Ministerium der Auswärtigen Angelegenheiten (*Royal Foreign Office*).

3341. Königliches [Preussisches] Ministerium der Geistlichen-Unterrichts- und Medicinal-Angelegenheiten (*Royal Department of Worship, Education, and Medicinal Affairs*).

3343. Königliches [Preussisches] Ministerium des Innern (*Royal Interior Department*). [i]

3345. Königliches [Preussisches] Ministerium für Handel und Gewerbe (*Royal Department of Commerce and Trade*). [i]

3347. Königliches [Preussisches] Ministerium für Landwirthschaft, Domänen und Forsten (*Royal Department of Agriculture, Domains, and Forests*). [i]

3349. Königliches [Preussisches] Ministerium für Oeffentliche Arbeiten (*Royal Department of Public Works*).

3351. Königliche [Preussische] Münze (*Royal Mint*).

3353. Königliche [Preussische] Museen, General-Direction (*Director General of the Royal Museums*). [iii]

3355. Königliches [Preussisches] Ober-Berg-Amt (*Royal Mining Bureau*).

3357. Königliche [Preussische] Staats-Archive (*Royal National Archives*) [in the Presidency of the Ministry of State].

3359. Königliches [Preussisches] Staats-Ministerium (*Royal Department of State*).

Berlin (*Prussia*)—Continued.

3361. Königliches [Preussisches] Statistisches Bureau (*Royal Statistical Bureau*). [i]

3363. Königliche [Preussische] Statistische Central-Kommission (*Royal Statistical Central Commission*).

3365. Königliche [Preussische] Sternwarte (*Royal Observatory*). [i]

3367. Königliches [Preussisches] Strafgefängniss am Plötzensee (*Royal Prison*). [i]

3369. Königliches [Preussisches] Topographisches Bureau im Grossen General-Stab (*Royal Topographical Bureau, General Staff of the Army*).

3371. Königliche [Preussische] Technische Hochschule (*Royal Polytechnical College*). [i]

3373. Königliche [Preussische] Vereinigte Artillerie- und Ingenieur-Schule (*Royal Artillery and Engineering School*). [i]

3375. Kongress Deutscher Landwirthe (*Congress of German Agriculturists*).

3377. Kriegsgeschichtliche Abtheilung im Grossen General-Stab (*Division of War Records, General Staff of the Army*).

3379. Landwirthschaftlicher Verein der Provinz Brandenburg (*Agricultural Society of the Province of Brandenburg*).

3381. Literarischer Club (*Literary Club*).

3383. Magistrat der Hauptstadt (*City Government*). [i]

3385. Märkisches Provinzial Museum (*Provincial Museum of Brandenburg*).

3387. Mathematischer Verein der Königlichen Universität (*Mathematical Association of the Royal University*).

3389. Medizinisch-Chirurgische Akademie für das Militair (*Military Medical Chirurgical Academy*).

3391. Medizinisch-Chirurgisches Friedrich-Wilhelms-Institut [Pépinière] (*Frederick William Medico-Chirurgical Institute*).

3393. Medizinisch-Chirurgische Gesellschaft (*Medico-Chirurgical Society*).

[Medizinische Gesellschaft. (See Berliner Medizinische Gesellschaft.)]

3395. Medizinische Klinik der Universität (*Medical Clinic of the University*).

3397. Medizinisch-Pädogogischer Verein (*Medico-Pedagogical Association*).

3399. Militärische Gesellschaft (*Military Society*).

3401. Mineralien-Cabinet der Universität (*Mineralogical Museum of the University*).

Berlin (*Prussia*)—Continued.

3403. Nachrichten-Bureau des Grossen General-Stabs (*Bureau of Information of the General Staff of the Army*).
3405. National-Gallerie (*National Gallery*).
3407. Numismatische Gesellschaft (*Numismatic Society*).
3409. "Ornis" Gesellschaft für Vogel-Kunde und Liebhaberei ("*Ornis*" *Ornithological Society*).
3411. Pflanzen Physiologisches Institut der Universität (*Institute of Vegetable Physiology of the University*).)
3413. Pharmakologisches Institut der Universität (*Pharmacological Institute of the University*).
3415. Philologischer Verein (*Philological Association*).
3417. Philosophische Gesellschaft (*Philosophical Society*).
3419. Photographischer Verein zu Berlin (*Photographical Association of Berlin*).
3421. Physikalische Gesellschaft (*Physical Society*). [i]
3423. Physiologische Gesellschaft (*Physiological Society*). [i]
3425. Physikalisches Institut der Universität (*Physical Institute of the University*).
3427. Physiologisches Institut der Universität (*Physiological Institute of the University*).
3429. Poliklinik der Universität (*Policlinic of the University*).
3431. Polytechnische Gesellschaft (*Polytechnic Society*). [i]
3433. Preussische Haupt-Bibel-Gesellschaft (*Prussian Bible Society*). [i]
3435. Rauch Museum (*Rauch Museum*).
3437. Redaktion: "Annalen für die Hydrographie" (*Annals of Hydrography*).
3439. Redaktion: "Arbeiterfreund" (*Friend of the Working Man*).
3441. Redaktion: "Archiv für Eisenbahnwesen" (*Railroad Archives*).

Redaktion: "Archiv für Post- und Telegraphie" (*Archives for Post and Telegraphic Affairs*).

3443. Redaktion: "Allgemeine Medizinische Central-Zeitung" (*General Medical Central Gazette*).
3445. Redaktion: "Allgemeine Zeitschrift für Psychiatrie und Psychiatrisch-Gerichtliche Medizin" (*Gazette for Psychiatry and Criminal Psychiatric Medicine*).
3447. Redaktion: "Archäologische Zeitung" (*Archæological Gazette*).
3449. Redaktion: "Archiv für die Artillerie- und Ingenieur Officiere des Deutschen Reichsheeres" (*Archives of the Artillery and Engineer Officers of the German Army*).
3451. Redaktion: "Archiv für Gynäkologie" (*Archives of Gynæcology*).
3453. Redaktion: "Archiv für Kirchliche Kunst" (*Archives of Ecclesiastical Art*).

Berlin (*Prussia*)—Continued.

3455. Redaktion: "Archiv für Klinische Chirurgie" (*Archives of Clinical Chirurgy*).

3457. Redaktion: "Archiv für Naturgeschichte" [13 Brüder Strasse] (*Archives of Natural History*), [formerly Troschel Archiv, Bonn]. [i]

3459. Redaktion: "[Virchow] Archiv für Pathologische Anatomie" (*Virchow Archives of Pathological Anatomy*). [i]

3461. Redaktion: "Archiv für Psychiatrie und Nervenkrankheiten" (*Archives of Psychiatry and Nervous Diseases*).

3463. Redaktion: "Archiv für Slavische Philologie" (*Archives of Sclavonic Philology*).

3465. Redaktion: "Archiv für wissenschaftliche und praktische Thierheilkunde" (*Archives of the Science and Practice of Veterinary Pathology*).

3467. Redaktion: "Archiv des Deutschen Landwirthschaftsraths" (*Archives of the German Agricultural Council*).

3469. Redaktion: "Archiv für Syphilis und Hautkrankheiten" (*Archives of Syphilis and Skin Diseases*).

3471. Redaktion: "Aus Allen Zeiten und Landen" (*From all Times and Countries*).

3473. Redaktion: "Berliner Jahrbuch" (*Berlin Annual*).

3475. Redaktion: "Berliner Blätter für Naturgemässe Lebensweise" (*Vegetarian Journal*).

3477. Redaktion: "Berliner Entomologische Zeitschrift" (*Berlin Entomological Gazette*).

3479. Redaktion: "Berliner Klinische Wochenschrift" (*Berlin Clinical Weekly*).

3481. Redaktion: "Berliner Münzblätter" (*Berlin Numismatic Journal*).

3483. Redaktion: "Botanischer Jahresbericht" (*Botanical Annual*).

3485. Redaktion: "Central-Blatt für die Medizinische Wissenschaft" (*Central Journal of Medical Sciences*).

3487. Redaktion: "Central-Blatt für W. Stoltze's Stenographie" (*Central Journal of Stenography*).

3489. Redaktion: "Chemische Industrie" (*Chemical Industry*).

3491. Redaktion: "Chemisch-Technisches Wochenblatt (*Chemico-Technical Weekly*).

3493. Redaktion: "Communal-Blatt für die Haupt- und Residenz-Stadt Berlin" (*Official Journal of the City of Berlin*).

3495. Redaktion: "Der Deutsche Herald" (*The German Herald*).

3497. Redaktion: "Der Deutsche Schulmann" [Pädagogik Journal]. (*The German Pedagogue*).

3499. Redaktion: "Das Rothe Kreuz" (*The Red Cross*).

Berlin (*Prussia*)—Continued.

3501. Redaktion: "Deutsche Blätter für Stenographie" (*German Stenographic Journal*).

3503. Redaktion: "Deutsche Entomologische Zeitschrift (*German Entomological Gazette*).

3505. Redaktion: Deutsche Heeres-Zeitung (*German Army Gazette*).

3507. Redaktion: "Deutsche Juristen-Zeitung" (*German Jurists' Gazette*).

3509. Redaktion: "Deutsche Allgemeine Polytechnische Zeitung" (*German General Polytechnic Gazette*).

3511. Redaktion: "Deutsche Konsulats-Zeitung" (*German Consular Gazette*).

3513. Redaktion: "Deutsche Landwirthschaftliche Presse" (*German Agricultural Journal*).

3515. Redaktion: "Deutsche Literaten-Zeitung" (*German Literati Gazette*).

3517. Redaktion: "Deutsche Medizinische Wochenschrift" (*German Medical Weekly*).

3519. Redaktion: Deutsche Militärärztliche Zeitung "(*German Military Surgeons' Gazette*).

3521. Redaktion: "Deutsche Rechtsanwalts-Zeitung" (*German Advocates' Gazette*).

3523. Redaktion: "Deutsche Rundschau" (*German Review*). [i]

3525. Redaktion: "Deutsche Schulzeitung" (*German School Gazette*).

3527. Redaktion: "Deutsche Thierschutz-Zeitung" (*German Gazette for Protection of Animals*).

3529. Redaktion: "Deutsche Fischerei-Zeitung" (*German Fisheries Gazette*).

3531. Redaktion: "Deutsches Handels-Archiv" (*German Commercial Archives*).

3533. Redaktion: "Deutsches Reich und Königlich-Preussischer Staats-Anzeiger" (*Imperial German and Royal Prussian Official Gazette*).

3535. Redaktion: "Elektrotechnische Zeitschrift" (*Electrotechnical Gazette*).

3537. Redaktion: "Forstwissenschaftliches Central-Blatt" (*Central Forestry Gazette*).

3539. Redaktion: "Fortschritte der Physik" (*Progress of Physics*).

3541. Redaktion: "Gefiederte Welt" (*Poultry World*).

3543. Redaktion: "Gegenwart [Die]" (*The Times*).

3545. Redaktion: "Gesetz-Sammlung für die Königlich-Preussischen Staaten" (*Royal Prussian Law Journal*).

3547. Redaktion: "Globus" (*Globus Geographical Journal*).

Berlin (*Prussia*)—Continued.

3549. Redaktion: "[von] Graefe's Archiv für Ophthalmologie" (*Graefe Archives of Ophthalmology*).

3551. Redaktion: "Grunert Archiv für die Mathematik" (*Grunert Archives of Mathematics*).

3553. Redaktion: "Hebräische Bibliographie" (*Hebrew Bibliography*).

3555. Redaktion: "Hermes Zeitschrift für Klassische Philologie" (*Hermes Journal of Classical Philology*).

3557. Redaktion: "Illustrirtes Patent-Blatt" (*Illustrated Patent Gazette*).

3559. Redaktion: "Isis, Zeitschrift für alle Naturwissenschaftlichen Liebhabereien" (*Isis, Journal of Natural Scientific Subjects*).

3561. Redaktion: "Illustrirte Roman-Zeitung" (*Illustrated Novel Journal*).

3563. Redaktion: "Jahrbuch des Königlichen Botanischen Gartens" (*Annals of the Royal Botanical Garden*).

3565. Redaktion: "Jahrbuch der Königlichen Kunstsammlungen" (*Annals of the Royal Museum*).

3567. Redaktion: "Jahrbuch für die Deutsche Armee und Marine" (*Annals of the German Army and Navy*). [i]

3569. Redaktion: "Jahrbuch für praktische Aerzte" (*Annals of Practical Physicians*).

3571. Redaktion: "Jahrburch für Wissenschaftliche Botanik" (*Annals of Scientific Botany*). [i]

3573. Redaktion: "Jahrbuch über den Fortschritt der Klassischen Alterthumswissenschaft" (*Annals of the Progress of Classical Archæology*).

3575. Redaktion: "Jahrbuch über die Fortschritte der Mathematik" (*Annals of the Progress of Mathematics*).

3577. Redaktion: "Jahrbuch über die Germanische Philologie" (*Annals of German Philology*).

3579. Redaktion: "Jahresbericht über den Fortschritt auf dem Gebiete der Gesammten Agriculturchemie" (*Annals of the Progress of Agricultural Chemistry*).

3581. Redaktion: "Jahresberichte der Geschichts-Wissenschaft" (*Annals of Historical Science*).

3583. Redaktion: "Jahresberichte der Physiologie" (*Annals of Physiology*). [i]

3585. Redaktion: "Jahresberichte über die Leistungen der Gesammten Medizin" (*Annals of the Results of Medicine*). [i].

3587. Redaktion: "Journal für die reine und angewandte Mathematik" (*Journal of Pure and Applied Mathematics*).

Berlin (*Prussia*)—Continued.

3589. Redaktion: "Journal für Ornithologie" (*Journal of Ornithology*). [i]

3591. Redaktion: "Juristische Wochenschrift" (*Jurists' Weekly*).

3593. Redaktion: "Landwirthschaftliche Jahrbücher" [Central-Blatt für Deutschland] (*Agricultural Annals*). [i]

3595. Redaktion: "Magazin für die Jüdische Geschichte und Literatur" (*Magazine of Jewish History and Literature*).

3597. Redaktion: "Magazin für die Literatur des In- und Auslandes" (*Magazine of Domestic and Foreign Literature*).

3599. Redaktion: "Magazin für Stenographie" (*Magazine of Stenography*).

3601. Redaktion: "Militär-Wochenblatt" (*Military Weekly*).

3603. Redaktion: "Monatsschrift für Ohrenheilkunde" (*Auriculists' Monthly*).

3605. Redaktion: "Nachrichten für Seefahrer" (*Information for Mariners*).

3607. Redaktion: "Naturæ Novitates" (*News of Nature*).

3609. Redaktion: "Der Naturforscher" (*The Naturalist*). [i]

3611. Redaktion: "Nautisches Jahrbuch" (*Nautical Almanac*). [i]

3613. Redaktion: "Neue Aera" (*New Era*).

3615. Redaktion: "Pädagogische Zeitung" (*Pædagogical Gazette*).

3617. Redaktion: "Pädagogischer Anzeiger" (*Pædagogical Journal*).

3619. Redaktion: "Pädagogisches Intelligenz-Blatt" (*Pædagogical News*).

3621. Redaktion: "Patent-Blatt" (*Patent Gazette*).

3623. Redaktion: "Physiologische Wochenschrift" (*Physiological Weekly*).

3625. Redaktion: "Provinzial-Correspondenz" (*Provincial Correspondence*).

3627. Redaktion: "Repertorium der Wissenschaften" (*Repertory of Sciences*).

3629. Redaktion: "Statistische Correspondenz" (*Statistical Correspondence*).

3631. Redaktion: "Vierteljahrsschrift für Gerichtliche Medizin und öffentliches Sanitätswesen" (*Quarterly Journal of Criminal Medicine and Public Hygiene*). [i]

3633. Redaktion: "Vierteljahrsschrift für Heraldik, Sphragistik und Genealogie" (*Quarterly Journal of Genealogy, &c.*).

[Redaktion: "Virchow Archiv." (See Archiv für Pathologische Anatomie.)]

3635. Redaktion: "Wiedemann's Annalen der Physik und Chemie" (*Wiedemann's Annals of Physics and Chemistry*).

3637. Redaktion: "Zeitschrift für das Berg- und Hüttenwesen" (*Mining and Smelting Gazette*).

Berlin (*Prussia*)—Continued.

3639. Redaktion: "Zeitschrift für die Gesammten Naturwissenschaften" (*Gazette of Natural Sciences*). [i]
3641. Redaktion: "Zeitschrift für das Bauwesen" (*Architectural Gazette*).
3643. Redaktion: "Zeitschrift für Deutsches Alterthum und Deutsche Literatur (*Gazette of German Archæology and Literature*).
3645. Redaktion: "Zeitschrift für Ethnologie" (*Ethnological Gazette*). [i]
3647. Redaktion: "Zeitschrift für Klinische Medizin" (*Journal of Clinical Medicine*).
3649. Redaktion: "Zeitschrift für Mikroskopie" (*Journal of Microscopy*).
3651. Redaktion: "Zeitschrift für Mikroskopie und Fleischschau" (*Journal of Microscopy and Inspection of Meat*).
3653. Redaktion: "Zeitschrift für Numismatik" (*Gazette of Numismatics*).
3655. Redaktion: "Zeitschrift für Preussische Geschichte und Landeskunde" (*Gazette of Prussian History and Geography*).
3657. Redaktion: "Zeitschrift für Preussisches Recht" (*Gazette of Prussian Law*).
3659. Redaktion: "Zeitschrift für Vergleichende Sprachforschung auf dem Gebiete der Indo-Germanischen Sprachen" (*Gazette of Comparative Linguistics*).
3661. Schule des General-Stabs der Königlich-Preussischen Armee (*School of the General Staff of the Royal Prussian Army*).
3663. Societät für Wissenschaftliche Kritik (*Society of Scientific Criticism*).
3665. Städtisches Statistisches Bureau (*Statistical Bureau of the City*). [i]
3667. Stenographischer Verein (*Stenographers' Association*). [i]
3669. Technische Deputation für Gewerbe [Ministry of Commerce] (*Technical Commission for Trade*).
3671. Technologisches Institut (*Technological Institute*).
3673. Thierärztlicher Verein der Mark Brandenburg (*Veterinary Association of the Province of Brandenburg*).
3675. Thierschutz-Verein (*Society for the Protection of Animals*). [i]

[Universitäts-Bibliothek. (See Königlich-Preussische Friedrichs-Wilhelms-Universität.)]

3677. Verein Berliner Buchhändler (*Berlin Booksellers' Association*).
3679. Verein der Aerzte und Wundärzte (*Society of Physicians and Surgeons*).

[Verein der Apotheker. (See Berliner Apotheker-Verein.)]

Berlin (*Prussia*)—Continued.

3681. Verein der Preussischen Rechts-Anwälte (*Prussian Lawyer's Association*).
3683. Verein Deutscher Eisenbahn-Verwaltungen (*Association of German Railroad Managers*). [i]
3685. Verein Deutscher Ingenieure (*German Engineers' Association*). [i]
3687. Verein für die Geschichte Berlins (*Association for the History of Berlin*).
3689. Verein für die Deutsche Literatur (*Association for German Literature*).
3691. Verein für die Deutsche Statistik (*Association for the Statistics of Germany*).
3693. Verein für Eisenbahnkunde (*Association for Railroad Engineering*). [i]
3695. Verein für Feuerbestattung (*Cremation Society*).
3697. Verein für die Geschichte der Mark-Brandenburg (*Society for the History of the Province of Brandenburg*). [i]
3699. Verein für Deutsche Volkswirthschaft (*Association for German Popular Economy*).
3701. Verein für Innere Medizin (*Association for Internal Medicine*).
3703. Verein für Praktische Thierärzte (*Association of Practical Veterinary Surgeons*).
3705. Verein zur Beförderung des Gartenbaues in den Königlich-Preussischen Staaten (*Society for the Promotion of Horticulture in the Royal Prussian States*). [iii]
3707. Verein zur Beförderung des Gewerbefleisses (*Association for the Promotion of Industry*). [i]
3709. Verein zur Förderung der Handelsfreiheit (*Society for the Promotion of Free Trade*).
3711. Verein zur Förderung der Photographie (*Society for the Promotion of Photography*). [i]
3713. Volkswirthschaftliche Gesellschaft (*Society of Popular Economy*).
3715. Volkswirthschafts-Rath (*Council for Popular Economy*).
3717. Wissenschaftlicher Central-Verein (*Scientific Central Association*).
3719. Ziegler- und Kalkbrenner-Verein (*Society of Brick and Lime Kiln Proprietors*). [i]
3721. Zoologischer Garten (*Zoological Garden*). [i]
3723. Zoologisches Museum der Universität (*Zoological Museum of the University*). [i]

Bielefeld (*Prussia*).

3725. Historischer Verein für die Grafschaft Ravensberg (*Historical Society of the Earldom of Ravensberg*).

Blankenburg (*Prussia*).

[Naturwissenschaftlicher Verein des Harzes. Defunct. Superseded by Gräfliche Oeffentliche Bibliothek, Wernigeroda.]

Blasewitz [*bei Dresden*] (*Saxony*).

3727. Museum Ludwig Salvator (*Ludwig Salvator Museum*). [i]

Bonn (*Prussia*).

3729. Görres Gesellschaft zur Pflege der Wissenschaft im Katholischen Deutschland (*Görres Society for the Promotion of Science in Catholic Germany*).

3731. K.-Preussisches Ober-Berg-Amt (*Royal Prussian Mining Department*).

3733. Landwirthschaftlicher Central-Verein für Rhein-Preussen (*Central Agricultural Society of Rhenish Prussia*). [i]

3735. Mineralogisches Museum und Institut der Universität (*Mineralogical Museum and Institute of the University*).

3737. Naturhistorischer Verein der Preussischen Rheinlande und Westfalens (*Natural History Society of the Rhenish Provinces and Westphalia*). [iii]

3739. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]

3741. Niederrheinische Gesellschaft für Natur- und Heilkunde (*Nether-Rhenish Society of Natural and Medical Sciences*). [i]

3743. Niederrheinischer Verein für œffentliche Gesundheitspflege (*Nether-Rhenish Association for Public Hygiene*).

3745. Redaktion des Archivs für die gesammte Physiologie des Menschen und der Thiere (*Archives of the Physiology of Man and Beast*). [i]

[Redaktion des Troschel'schen Archiv—now in Berlin.]

3747. Societa Philologa (*Philological Society*).

3749. Universitäts-Bibliothek (*Library of the University*). [iii]

3751. Verband der Aerztlichen Vereine im Rheinland, Nassau, Westfalen und Lothringen (*Association of Medical Societies in the Rhenish Provinces, Nassau, Westphalia, and Lorraine*).

3753. Universitäts-Sternwarte (*University Observatory*). [i]

3755. Verein von Alterthumsfreunden im Rheinlande (*Society of Archæologists of the Rhenish Provinces*). [i]

Boothcamp [*near Kiel*] (*Prussia*).

3757. Sternwarte (*Observatory*). [i]

Brandenburg a. Havel (*Prussia*).

3759. Historischer Verein (*Historical Society*). [i]

Braunsberg (*Prussia*).

3761. Historischer Verein für Ermland (*Historical Society of Ermland*).
3763. Redaktion: "Vereinigte Frauendorfer Blätter" (*United Frauendorf Journal* [formerly in Frauendorf].

Braunschweig (*Brunswick*).

3764. Archiv für Anthropologie (*Archives of Anthropology*).
3765. Archiv für das Studium der Neueren Sprachen und Literaturen (*Archives for the Study of the Modern Languages and Literature*).
3767. Deutsche Gesellschaft für Anthropologie, Ethnologie und Urgeschichte (*German Society of Anthropology, Ethnology, and Primitive History*).
3769. Deutsche Ornithologische Gesellschaft (*German Ornithological Society*). [i]
3771. Gartenbau-Gesellschaft (*Horticultural Society*). [i]
3773. "Globus."
3775. Herzogliches Naturhistorisches Museum (*Ducal Natural History Museum*). [i]
3777. Stadt-Bibliothek (*City Library*). [i]
3779. Verein für Naturwissenschaften (*Society of Natural Sciences*). [i]
3781. Verein für öffentliche Gesundheitspflege im Herzogthum (*Society for Public Hygiene*).
3783. F. Vieweg u. Sohn (*F. Vieweg & Son*). [iii]

Bremen (*Germany*).

3785. Bibliothek des Museums (*Library of the Museum*). [i]
3787. Bremer Regierung (*Bremen Government*). [i]
3789. Bureau für Bremische Statistik (*Bureau of Bremen Statistics*). [i]
3791. Gartenbau-Verein für Bremen (*Bremen Horticultural Society*). [i]
3793. Geographische Gesellschaft (*Geographical Society*). [i]
3795. Handels-Kammer (*Chamber of Commerce*). [i]
3797. Historische Gesellschaft des Künstler-Vereins (*Historical Society of the Artists' Union*). [i]
3799. Landwirthschafts-Verein (*Agricultural Society*). [i]
3801. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]
3803. Nord-Deutcher Lloyd Dampfschiff-Gesellschaft (*North German Lloyd Steamship Company*). [i]
3805. Observatorium der Navigations-Schule (*Observatory of the School of Navigation*). [i]
3807. Stadt-Bibliothek (*City Library*). [iii]

Breslau (*Prussia*).

3809. Blinden-Anstalt (*Asylum for the Blind*). [i]
3811. Botanischer Garten (*Botanical Garden*).
3813. Breslauer Dichterschule (*Breslau School of Poetry*).
3815. Deutscher und Oesterreichischer Alpen-Verein, Section Breslau (*German and Austrian Alpine Association, Breslau Section*).
3817. Königlich-Preussisches Ober-Berg-Amt (*Royal Prussian Mining Bureau*). [i]
3819. Landwirthschaftlicher Central-Verein für Schlesien (*Central Agricultural Society for Silesia*). [i].
3821. Physikalischer Verein (*Physical Society*).
3823. Physiologisches Institut (*Physiological Institute*). [i]
3825. Schlesischer Central-Gewerbe-Verein (*Silesian Central Polytechnical Society*). [i]
3827. Schlesische Gesellschaft für Vaterländische Kultur (*Silesian Society for National Improvement*). [i]
3829. Universitäts-Bibliothek (*University Library*). [iii]
3831. Universitäts-Sternwarte (*University Observatory*). [i]
3833. Verein für Geschichte der Bildenden Kunst (*Society of the History of Plastic Art*).
3835. Verein für Geschichte und Alterthümer Schlesiens (*Society of Silesian History and Antiquities*).
3837. Verein für das Museum Schlesischer Alterthümer (*Society of the Museum of Silesian Antiquities*). [i]
3839. Verein für Schlesische Insektenkunde (*Society of Silesian Entomology*). [i]

Bromberg (*Prussia*).

3841. Landwirthschaftlicher Central-Verein für den Netze District (*Agricultural Central Union for the District of Netze*). [i]

Cassel. (See Kassel.)

Celle (*Prussia*).

3843. Journal für die Landwirthschaft (*Agricultural Journal*).
3845. Königliche Landwirthschafts-Gesellschaft (*Royal Agricultural Society*). [i]

Chemnitz (*Saxony*).

3847. Handwerker-Verein (*Mechanics' Association*). [i]
3849. Königlich-Sächsisches Meteorologisches Institut (*Royal Saxon Meteorological Institute*) [formerly in Leipsic]. [i]
3851. Naturwissenschaftliche Gesellschaft (*Society of Natural Sciences*). [i]
3853. Oeffentliche Handels - Lehr - Anstalt (*Public Commercial School*). [i]

Chemnitz (*Saxony*)—Continued.

3855. Redaktion der Deutschen Industrie-Zeitung (*German Industrial Gazette*). [i]
3857. Statistisches Bureau (*Statistical Bureau*). [i]
3859. Technische Staats-Lehr-Anstalt (*School of Technology*). [i]
3861. Verein für Chemnitzer Geschichte (*Society for the History of Chemnitz*). [i]

Coblenz. (See Koblenz.)

Colmar (*Alsace*).

3863. Société d'Histoire Naturelle de Colmar (*Colmar Natural History Society*). [i]

Danzig (*Prussia*).

3865. Central-Verein West-Preussischer Landwirthe (*Central Association of West Prussian Agriculturists*). [i]
3867. Naturforschende Gesellschaft (*Society of Natural Sciences*). [iii]
3869. Sternwarte [der Naturforschenden Gesellschaft] (*Observatory*). [i]
3871. West-Preussischer Geschichts-Verein (*West Prussian Historical Society*).

Darmstadt (*Hesse*).

3873. Gartenbau-Verein (*Horticultural Society*). [i]
3875. Grossherzogliche Central-Stelle für Gewerbe und Handel (*Grand Ducal Bureau of Industry and Commerce*). [i]
3877. Grossherzogliche Central-Stelle für die Landes-Statistik (*Grand Ducal Bureau of Statistics*). [i]
3879. Grossherzogliche Geologische Anstalt (*Grand Ducal Geological Bureau*).
3881. Grossherzogliche Hof- Bibliothek (*Grand Ducal Library*). [iii]
3883. Grossherzogliche Technische Hochschule (*Grand Ducal Polytechnicum*). [i]
3885. Grossherzoglich-Hessischer Gewerbe-Verein (*Grand Ducal Polytechnical Society*). [i]
3887. Grossherzoglich-Hessisches Kataster-Amt (*Grand Ducal Bureau of Land Records*). [i]
3889. Grossherzogliches Ministerium des Aeussern (*Grand Ducal Foreign Office*).
3891. Grossherzogliches Museum (*Grand Ducal Museum*). [i]
3893. Historischer Verein für das Grossherzogthum Hessen (*Historical Society of the Grand Duchy of Hesse*). [i]
3895. Jahresberichte für reine Chemie (*Chemical Annals*).
3897. Mittelrheinischer Geologischer Verein (*Geological Society of the Middle Rhine*).
3899. Verein für Erdkunde und Verwandte Wissenschaften (*Society of Geographical and Kindred Sciences*). [i]

Dessau (*Anhalt*).

3901. Naturhistorischer Verein (*Natural History Society*). [i]
3903. Verein für Anhaltische Geschichte und Alterthumskunde (*Society of the History and Antiquities of Anhalt*).

Donaueschingen (*Baden*).

3905. Verein für Geschichte und Naturgeschichte der Baar (*Society of History and Natural History of the Baar*). [i]

Dortmund (*Prussia*).

3907. Historischer Verein für Dortmund und die Grafschaft Mark (*Historical Society of Dortmund and the Earldom of Mark*).

Dresden (*Saxony*).

3909. Seine Majestät der König von Sachsen (*His Majesty the King of Saxony*). [iii]
3911. Afrikanische Gesellschaft (*African Society*). [i]
3913. Bezirks-Verein zur Fürsorge für die aus Straf- und Bestrafungs- Anstalten Entlassenen (*District Society for the Care of Discharged Prisoners*).
3915. Blätter für Geflügelzucht (*Journal of Poultry Culture*).
3917. Dresdner Verein zum Schutz der Thiere (*Dresden Society for the Protection of Animals*).
3919. Deutscher und Oesterreichischer Alpen-Verein, Section Dresden (*Dresden Section of the German-Austrian Alpine Society*).
3921. Flora: Gesellschaft für Botanik und Gartenbau (*Botanical and Horticultural Society, "Flora"*). [i]
3923. Gebirgs-Verein für die Sächsisch-Böhmische Schweiz (*Montanistic Society of Saxon-Bohemian Switzerland*).
3925. General Direktion der Königlichen Sammlungen für Kunst und Wissenschaft (*Director-General of the Royal Collections of Art and Science*). [iii]
3927. Gesellschaft für Botanik und Zoologie (*Botanical and Zoological Society*). [i]
3929. Gesellschaft für Natur-und Heilkunde (*Society of Natural and Medical Sciences*). [i]
3931. Gesellschaft für Sächsische Kirchengeschichte (*Society for Ecclesiastical History in Saxony*).
3933. Gewerbe-Verein (*Polytechnical Society*). [i]
3935. Königliches Historisches Museum (*Royal Historical Museum*). [i]
3937. Königliche Landes-Blinden-Anstalt (*Royal Asylum for the Blind*). [i]
3939. Königliches Mineralogisch und Naturhistorisches Museum (*Royal Mineralogical and Natural Historical Museum*). [i]

Dresden (*Saxony*)—Continued.

3941. Königliches Ministerium des Aeussern (*Royal Foreign Office*).
3943. Königliches Ministerium für Cultus und Unterricht (*Royal Department of Worship and Education*).
3945. Königliche Oeffentliche Bibliothek (*Royal Public Library*). [iii]
3947. Königliche Oekonomie-Gesellschaft im Königreich Sachsen (*Royal Saxon Agricultural Society*). [i]
3949. Königliches Polytechnikum (*Royal Polytechnicum*). [i]
[Königliches Sanitäts-Officiers-Corps. (See Königliche Sanitäts-Direction.)]
3951. Königliche Sanitäts-Direction (*Royal Board of Health*). [i]
3953. Königliches Statistisches Bureau (*Royal Statistical Bureau*). [i]
3955. Königliches Stenographisches Institut (*Royal Stenographic Institute*). [i]
3957. Königliches Topographisches Bureau [Kriegs-Ministerium] (*Royal Topographical Bureau*).
3959. Königliches Zoologisches und Anthropologisch-Ethnographisches Museum (*Royal Zoological and Anthropologic-Ethnographical Museum*). [i]
3961. Landes-Medicinal-Collegium (*National Medical Commission*). [i]
3963. Ministerium des Königlichen Hauses (*Ministry of the Royal Household*). [i]
3965. Naturwissenschaftliche Gesellschaft "Isis" ("*Isis" Society of Natural Sciences*). [i]
3967. Numismatische Gesellschaft (*Numismatic Society*).
3969. Oeffentliche Handels-Lehr-Anstalt der Dresdener Kaufmannschaft (*Public Commercial School of the Dresden Merchants*). [i]
3971. Photographische Gesellschaft (*Photographical Society*). [i]
3973. Redaktion des Archiv für Sächsische Geschichte (*Archives of the History of Saxony*).
3975. Sächsischer Ingenieur und Architecten-Verein (*Saxon Engineers' and Architects' Association*). [i]
3977. Verein für Erdkunde (*Geographical Society*). [i]
3979. Verein für Geschichte und Topographie Dresdens und seiner Umgebung (*Society for the History and Topography of Dresden and its Surroundings*).
3981. Königlich-Sächsischer Verein für Alterthümer (*Royal Saxon Antiquarian Society*). [i]

Dürkheim (*Bavaria*).

3983. "Pollichia" Naturwissenschaftlicher Verein der Rheinpfalz ("*Pollichia," Society of Natural Science of the Rhenish Palatinate*). [i]

Düsseldorf (*Prussia*).

3985. Düsseldorfer Geschichts-Verein (*Düsseldorf Historical Society*).
3987. Niederrheinischer Verein für öffentliche Gesundheitspflege (*Nether-Rhenish Society of Public Hygiene*).
3989. Rheinisch-Westfälische Gefängniss Gesellschaft (*Rhenish-Westphalian Prison Association*).
3991. Sternwarte (*Observatory*). [i]
3993. Verein zur Wahrung der gemeinsamen wirthschaftlichen Interessen im Rheinlande und in Westfalen (*Society of Economical Interests in Rhenish Prussia and Westfalia*).
3995. Zweig-Verein des Deutschen Colonial-Vereins in Frankfurt a. M. (*Branch of the German Colonial Society of Frankfort-on-the-Main*).

Eisenach (*Saxe-Weimar*).

3997. Grossherzogliches Carl-Friedrichs-Gymnasium (*Grand-Ducal Charles Frederick Gymnasium*).
3999. Real-Gymnasium ("*Real*" *Gymnasium*). [i]
4001. Thüringer Wald-Verein ("*Thuringer Wald*" *Society*).

Eisleben (*Prussia*).

4003. Verein für Geschichte und Alterthümer der Grafschaft Mansfeld (*Society of the History and Antiquities of the Earldom of Mansfeld*).

Elberfeld (*Prussia*).

4005. Bergischer Geschichts-Verein (*Berg Historical Society*). [i]
4007. Naturwissenschaftlicher Verein von Elberfeld und Barmen (*Elberfeld and Barmen Society of Natural Sciences*). [i]

Eldena [*bei Greifswald*] (*Prussia*).

4009. Gartenbau-Verein für Neuvorpommern und Rügen (*Horticultural Society of New Pomerania and Rugen*). [i]

[Landwirthschafts-Akademie (*Agricultural Academy*). Ceased to exist.]

Emden (*Prussia*).

4011. Gesellschaft für Bildende Künste und Vaterländische Alterthümer (*Society of Plastic Arts and National Antiquities*). (i)
4013. Naturforschende Gesellschaft (*Naturalists' Society*). [iii]
4015. Navigations-Schule (*School of Navigation*). [i]
4017. Taubstummen-Anstalt (*Institute for the Deaf and Dumb*). [i]

Ems (*Prussia*).

4019. Redaktion der Balneologischen Zeitung (*Balneological Gazette*). [i]

Erbach (*Hesse*).

4021. Odenwald Club (*Odenwald Club*).

Erfurt (*Prussia*).

4023. Allgemeiner Aerztlicher Verein von Thüringen (*General Society of Physicians of Thuringia*).
4025. Akademie gemeinnütziger Wissenschaften (*Academy of Useful Sciences*). [i]
4027. Gartenbau-Verein (*Horticultural Society*). [i]
4029. Gewerbe-Verein (*Polytechnical Society*). [i]
4031. Verein für Geschichte und Alterthums-Kunde (*Historical and Archæological Society*). [i]

Erlangen (*Bavaria*).

[Biologisches Central-Blatt. (See Physiologisches Institut.)]
4033. Physikalisch-Medicinische Societät (*Physico-Medical Society*). [i]
4035. Physiologisches Institut (*Physiological Institute*).
4037. Universitäts-Bibliothek (*University Library*). [iii]

Essen a. d. Ruhr (*Prussia*).

4039. Feldmesser-Verein (*Surveyors' Society*).
4041. Historischer Verein für Stadt und Stift Essen (*Historical Society of Essen*).
4043. Verein für Thierschutz und Geflügelzucht (*Society for the Protection of Animals and for the Culture of Poultry*).

Frankfurt-am-Main.

4045. Allgemeine Deutsche Patent- und Musterschutz-Ausstellung (*Universal Patent and Pattern Exhibition*). [i]
4047. American Public Library [formerly in Stuttgart]. [i].
4049. Deutsche Malakozoologische Gesellschaft (*German Malacozoological Society*). [i]
4051. Deutscher Kolonial-Verein (*German Colonial Society*).
4053. Freies Deutsches Hochstift (*Free German "Hochstift".*) [i]
4055. Gartenbau Gesellschaft "Flora" (*Horticultural Society, "Flora"*). [i]
[Gesellschaft für Deutschlands ältere Geschichtskunde. (See Central-Direction der Monumenta Germaniæ, in Berlin.)]
4057. Königliche Eisenbahn-Direction [Sachsenhausen] (*Royal Railroad Direction*).
4059. Juristische Gesellschaft (*Jurists' Society*).
4061. Neue Zoologische Gesellschaft (*New Zoological Society*). [i]
4063. Physikalischer und Aerztlicher Verein (*Physical and Medical Society*) [deposit its books with the Senckenbergische Bibliothek]. [i]
4065. Rheinisches Museum für Philologie (*Rhenish Philological Museum*).

Frankfurt-am-Main—Continued.

4067. Senckenbergische Bibliothek (*Senckenberg Library*).
4069. Senckenbergische Naturforschende Gesellschaft (*Senckenberg Naturalists' Society*) [deposits its books with the Seckenbergische Bibliothek]. [iii]
[Statistischer Verein (*Statistical Association*)—same as 4075].
4071. Verein für Geschichte und Alterthumskunde (*Historical and Archæological Association*). [i]
4073. Statistisches Amt der Stadt Frankfurt (*Statistical Bureau of the City of Frankfort.*)
4075. Verein für Geographie und Statistiks (*Society of Geography and Statistics*) [care of Stadt-Bibliothek]. [i]
4077. Taunus Club (*Taunus Club*).
4079. Verband Deutscher Touristen-Vereine (*Association of German Tourists' Societies*).
4081. "Zoologischer Garten" [Redaktion] ("*Zoological Garden*"). [i]

Frankfurt-an-der-Oder (*Prussia*).

4083. Historisch-Statistischer Verein (*Historical Statistical Association*). [i]
4085. Handels-Kammer (*Chamber of Commerce*). [i]

Frauenberg (*Prussia*).

[Historischer Verein für Ermeland. (See Braunsberg.)]

Frauendorf (*Bavaria*).

[Redaktion der Vereinigten Frauendorfer Blätter (*United Frauendorf Journal*). (See Braunsberg.)]

Freiberg (*Saxony*).

4087. Aerztlicher Verein (*Physicians' Society*).
4089. "Anglo-American Club."
4091. Bergmännischer Verein (*Miners' Association*).
4093. Freiberger Alterthums-Verein (*Freiberg Archæological Society*).
4095. Königlich-Sächsische Berg-Akademie (*Royal Saxon Mining Academy*). [iii]

Freiburg-im-Breisgau (*Baden*).

4097. Blinden-Beschäftigungs-Anstalt (*Establishment for the Employment of the Blind*). [i]
4099. Breisgau-Verein "Schau in's Land" (*Breisgau Society "Schau in's Land"*).
4101. Gesellschaft zur Beförderung der Geschichts-, Alterthums- und Volkskunde von Freiburg, dem Breisgau und den angrenzenden Landschaften (*Society for the Promotion of the Historical, Antiquarian, and Geographical Knowledge of Freiburg, the Breisgau, and the adjacent Territories*).

Freiburg-im-Breisgau (*Baden*)—Continued.

4103. Gesellschaft zur Beförderung der Naturwissenschaften (*Society for the Promotion of Natural Sciences*).

4105. Kirchlich-Historischer Verein der Erzdiöcese Freiburg (*Society for Ecclesiastical History of Freiburg*).

4107. Naturforschende Gesellschaft (*Naturalists' Society*). [i]

4109. Redaktion des "Archiv für Anthropologie" (*Archives of Anthropology*). [i]

4111. Universitäts-Bibliothek (*University Library*). [iii]

4113. Verein der Freiburger Aerzte (*Society of Freiburg Physicians*).

Freising (*Bavaria*).

4115. Königlich-Bayerische Landwirthschaftliche Central-Schule "Weihenstephan" (*Royal Bavarian Agricultural School "Weihenstephan"*). [i]

Friedberg (*Hesse*).

4117. Blinden-Anstalt (*Asylum for the Blind*). [i]

4119. Grossherzogliche Taubstummen-Anstalt (*Grand Ducal Institution for the Deaf and Dumb*). [i]

Friedrichshafen (*Wurtemberg*).

4121. Verein für die Geschichte des Bodensee's und seiner Umgebung (*Society for the History of Lake Constance and its Environs*).

Fulda (*Prussia*).

4123. Rhön Club (*Rhön Club*).

4125. Verein für Naturkunde (*Natural History Society*). [i]

Fürth (*Bavaria*).

4127. Gewerbe-Verein (*Polytechnical Association*). [i]

Gera (*Reuss*).

4129. Fürstlich-Reussische Landes-Regierung (*Government of Reuss Principality*).

4131. Gesellschaft der Freunde der Naturwissenschaften (*Society of the Friends of Natural Sciences*). [i]

Giessen (*Hesse*).

4133. Aerztlicher Verein der Provinz Oberhessen (*Physicians' Society of the Province of Upper Hesse*).

4135. Jahresberichte über die Fortschritte der reinen Chemie (*Annual Records of the Progress of pure Chemistry*).

4137. Oberhessische Gesellschaft für Natur- und Heilkunde (*Upper Hesse Society of Natural and Medical Sciences*). [iii]

4139. Oberhessischer Verein für Localgeschichte (*Upper Hesse Local Historical Society*). [i]

4141. Universitäts-Bibliothek (*University Library*). [iii]

4143. Zoologisches Museum (*Zoological Museum*). [i]

4145. Zoologisch-Zootomisches Institut der Universität (*Zoologic-Zootomical Institute of the University*).

Görlitz (*Prussia*).

4147. Gartenbau-Verein für die Ober-Lausitz (*Horticultural Society of Upper Lusatia*). [i]
4149. Gewerbe-Verein (*Polytechnical Association*). [i]
4151. Naturforschende Gesellschaft (*Naturalists' Society*). [iii]
4153. Oberlausitzer Gesellschaft der Wissenschaften (*Scientific Society of Upper Lusatia*). [iii]
4155. Verein für Geflügelzucht (*Society for Poultry Culture*). [i]

Göttingen (*Prussia*).

4157. Anthropologischer Verein (*Anthropological Society*). [Has no library.] [i]
4159. "Beiträge zur Kunde der Indo-Germanischen Sprachen" (*Contributions to the Knowledge of the Indo-Germanic Languages*).
4161. Botanischer Garten (*Botanical Garden*).
4163. Chemisches Laboratorium der Universität (*Chemical Laboratory of the University*).
4165. Biblioteca Mechanico-Technologico (*Mechanic-Technological Library*).
4167. Geognostisches Institut (*Geognostical Institute*).
4169. Gesellschaft für Kirchenrechtswissenschaft (*Society for Ecclesiastical Law*).
4171. Journal für Landwirthschaft (*Agricultural Journal*). [i]
4173. Königliche Societät der Wissenschaften (*Royal Society of Sciences*). [Transfer all books to University Library.] [i]
4175. Königliche Sternwarte (*Royal Observatory*). [i]
4177. Landwirthschaftliche Akademie (*Agricultural Academy*).
4179. Landwirthschaftlich-Chemisches Laboratorium (*Laboratory of Agricultural Chemistry*).
4181. Medicinisch-chirurgisch-ophthalmologisch-geburtshülfliche Klinik (*Medical, Surgical, Ophthalmological, Obstetrical Clinic*).
4183. Mineralogisches Institut (*Mineralogical Institute*).
4185. Paleontologisches Institut (*Palæontological Institute*).
4187. Pharmaceutisches Institut (*Pharmaceutical Institute*).
4189. "Philologischer Anzeiger" (*Philological Gazette*).
4191. "Philologus."
4193. Physikalisches Institut (*Physical Institute*).
4195. Physiologisches Institut (*Physiological Institute*).
4197. Universitäts-Bibliothek (*University Library*). [iii]
4199. Zeitschrift für Wissenschaftliche Zoologie (*Journal of Scientific Zoology*).
4201. Zoologisches Museum (*Zoological Museum*). [i]
4203. Zoologisch-Zootomisches Institut (*Zoologic-Zootomical Institute*). [i]

Gotha (*Saxe-Coburg*).

4205. Almanach de Gotha (*Almanach of Gotha*). [i]
4207. Geographische Anstalt [Justus Perthes] (*Geographical Establishment*). [iii]
4209. Herzogliche Bibliothek der Friedenstein'schen Sammlungen (*Ducal Library of the Friedenstein Collections*). [iii]
[Petermann's Geographische Mittheilungen. (See Geographische Anstalt.)]
4211. Sternwarte (*Observatory*). [i]
4213. Thüringer Gartenbau-Verein (*Horticultural Society*). [i]

Greifenberg-in-Pommern (*Prussia*).

4215. Pommersche Oekonomische Gesellschaft (*Agricultural Society of Pomerania*). [i]

Greifswald (*Prussia*).

4217. Baltischer Central-Verein zur Beförderung der Landwirthschaft (*Baltic Central Association for the Advancement of Agriculture*). [i]
4219. Geographische Gesellschaft (*Geographical Society*).
4221. Gesellschaft für Pommersche Geschichte und Alterthumskunde [Rügisch-Pommersche Abtheilung] (*Society of Pomeranian History and Archæology*). [i]
4223. Naturwissenschaftlicher Verein von Neuvorpommern und Rügen (*Society of Natural Sciences of New Pomerania and Rügen*).
4225. Universitäts-Bibliothek (*University Library*). [iii]

Greiz (*Reuss*).

4227. Fürstlich-Reuss'sche Landes-Regierung (*Government*).

Guben (*Prussia*).

[Lausitzer Gewerbe-Verein (*Polytechnical Society*).]

Gumbinnen (*Prussia*).

[Landwirthschaftlicher Central-Verein für Lithauen und Masuren (*Central Agricultural Association of Lithuania and Masuren*). (See Insterburg.)]

Güstrow (*Mecklenburg*).

4231. Verein der Freunde der Naturgeschichte in Mecklenburg [care of Opitz & Co., Güstrow] (*Society of Friends of Natural History in Mecklenburg*). [iii]

Halberstadt (*Prussia*).

[Deutsche Ornithologische Gesellschaft. (See Braunschweig.)]

Hall-am-Kocher [*Schwäbisch Hall*] (*Würtemberg*).

4233. Historischer Verein für das Würtembergische Franken (*Historical Society of Würtemberg Franconia*). [i]

Halle-an-der-Saale (*Prussia*).

4235. Deutscher Apotheker-Verein (*German Apothecaries' Association*). [i]
4237. Deutsche Morgenländische Gesellschaft (*German Oriental Society*). [i]
4239. Deutscher Verein zum Schutz der Vogelwelt (*German Society for the Protection of Birds*).
4241. Geschichtlicher Verein der Provinz Sachsen (*Historical Society of the Province of Saxony*).
4243. Kaiserliche Leopoldina Carolina Akademie der Deutschen Naturforscher (*Imperial Leopold-Carolus Academy of German Naturalists*). [iii]
4245. Königliches Ober Berg Amt (*Royal Mining Bureau*). [i]
4247. Königliche Vereinigte Friedrichs Universität Halle-Wittemberg [Bibliothek] (*University Library*). [iii]
4249. Landwirthschaftlicher Central-Verein für die Provinz-Sachsen (*Central Agricultural Association for the Province of Saxony*). [i]
4251. Naturforschende Gesellschaft (*Naturalists' Society*). [iii]
4253. Naturwissenschaftlicher Verein für Sachsen und Thüringen (*Scientific Association of Saxony and Thuringia*). [iii]
4255. Ornithologischer Central-Verein für Sachsen und Thüringen (*Central Ornithological Association of Saxony and Thuringia*). [i]
4257. Politisch-Oekonomisches Seminar (*Politic Economical Seminary*).
4259. Redaktion: "Archiv der Pharmacie" ("*Pharmaceutical Archives*").
4261. Redaktion: "Botanische Zeitung" (*Botanical Gazette*). [i]
4263. Redaktion: "Die Natur" [Dr. Karl Müller] ("*Nature*"). [i]
4265. Redaktion: "Zeitschrift für Deutsche Philologie" ("*Journal of German Philology*").
4267. Redaktion: "Zeitschrift für die gesammten Naturwissenschaften" (*Journal of Natural Sciences*). [Formerly in Berlin.]
4269. Thüringisch-Sächsischer [Geschichts- und Alterthums-] Verein für Erforschung des Vaterländischen Alterthums und Erhaltung seiner Denkmale (*Thuringo-Saxonian [Historical and Archæological] Society for the Exploration of National Antiquity and the Preservation of Antiquarian Monuments*). [i]
4271. Verein der Aerzte im Regierungsbezirk Merseburg und in dem Herzogthum Anhalt (*Society of Physicians in the District of Merseburg and the Duchy of Anhalt*).
4273. Verein für Erdkunde (*Geographical Society*). [i]
4275. Verein für Reformations-Geschichte (*Society for the History of the Reformation*).

Hamburg (*Germany*).

4277. Anthropologische Gesellschaft (*Anthropological Society*). [i]
4279. Bibliothek des Medicinal-Collegiums (*Library of the Medical College*).
4281 Blinden-Anstalt (*Institution for the Blind*). [i]
4283. Commerz-Bibliothek (*Commercial Library*). [iii]
4285. Deutsche Meteorologische Gesellschaft (*German Meteorological Society*).
4287. Geburtshülfliche Gesellschaft (*Gynæcological Society*).
4289. Geographische Gesellschaft (*Geographical Society*). [i]
4291. Gesellschaft für Botanik (*Botanical Society*).
4293. Gesellschaft von Freunden der Geographie (*Society of Friends of Geography*). [i]
4295. Handels-Kammer (*Chamber of Commerce*). [i]
4297. Johanneum. [i]
4299. Museum Godeffroy. [i]
4301. Naturhistorisches Museum [Dr. Pagenstecher] (*Natural History Museum*).
4303. Naturwissenschaftlicher Verein Hamburg-Altona (*Hamburg-Altona Society of Natural Sciences*). [iii]
4305. Nord-Deutsche Seewarte (*North German Naval Observatory*). [i]
4307. Stadt-Bibliothek (*City Library*). [iii]
4309. Sternwarte (*Observatory*). [i]
4311. Thierschutz-Verein (*Society for the Protection of Animals*). [i]
4313. Verein für Hamburgische Geschichte (*Society for Hamburg's History*). [i]
4315. Verein für Handelsfreiheit (*Free Trade Association*). [i]
4317. Verein für Naturwissenschaftliche Unterhaltung (*Society for Scientific Discourse*). [i]
4319. Verein für Oeffentliche Gesundheitspflege (*Society for Public Hygiene*).
4321. Verein für Niederdeutsche Sprachforschung (*Society of Low German Linguistics*).

Hamm (*Prussia*).

4325. Königliches Gymnasium (*Royal Gymnasium*).

Hanau (*Hesse*).

4327. Hanauer Bezirks-Verein für Hessische Geschichte und Landeskunde (*Hanau Society for Hessian History and Geography*). [i]
4329. Wetterauer Gesellschaft für die gesammte Naturkunde (*Wetterau Association for Natural Sciences in General*). [i]

Hannover (*Prussia*).

4331. Architekten- und Ingenieur-Verein (*Architects' and Engineers' Association*). [i]
4333. Central Münzforscher-Verein (*Central Numismatic Association*).
4335. Geographische Gesellschaft (*Geographical Society*). [i]
[Gesammt-Verein der Deutschen Geschichts- und Alterthums-Vereine (*Central Union of the German Historical and Archæological Societies*).]
4337. Gesellschaft für ältere Deutsche Geschichtskunde (*Society of Ancient German History*).
4339. Gesellschaft für Mikroskopie (*Microscopical Society*). [i]
4341. Gewerbe-Verein für die Provinz-Hannover (*Polytechnic Society of the Province of Hannover*). [i]
4343. Hahn'sche Buchhandlung (*Hahn's Bookstore*). [i]
4345. Historischer Verein für Niedersachsen (*Historical Society of Lower Saxony*). [i]
4347. Königliche Oeffentliche Bibliothek (*Royal Public Library*). [iii]
4349. Königliche Landwirthschafts Gesellschaft (*Royal Agricultural Society*).
4351. Königliche Technische Hochschule (*Royal Polytechnicum*). [i]
4353. "Kunst im Gewerbe" (*Art in Trade*).
4355. Naturhistorische Gesellschaft (*Natural History Society*). [i]
4357. Naturwissenschaftliche Gesellschaft (*Society of Natural Sciences*).
4359. Niedersächsischer Aerzte-Vereins-Bund (*Association of the Physicians' Societies of Lower Saxony*).
4361. Verein analytischer Chemiker in Deutschland (*Society of Analytical Chemists in Germany*).
4363. Verein für öffentliche Gesundheitspflege (*Society of Public Hygiene*).

Heidelberg (*Baden*).

4365. Landwirthschaftlicher Bezirks-Verein (*Agricultural Society*). [i]
4367. Naturhistorisch-Medicinischer Verein (*Society of Natural and Medical Sciences*). [i]
4369. Neues Jahrbuch für Mineralogie, Geologie und Paleontologie [Dr. Rosenbusch] (*New Year-book of Mineralogy, Geology, and Palæontology*). [i]
4371. Ophthalmologische Gesellschaft (*Ophthalmological Society*).
4373. Physiologisches Institut der Universität (*Physiological Institute of the University*).
4375. Universitäts-Bibliothek (*University Library*). [iii]
4377. Zoologisch-Anatomisches Institut der Universität (*Zoologico-Anatomical Institute of the University*).

Heilbronn (*Würtemberg*).

4379. Historischer Verein (*Historical Society*).
4381. "Irrenfreund" (*Friend of the Insane*).
4383. "Memorabilien."

Herrnhut (*Saxony*).

4385. Herrnhuter Brüder-Gemeinschaft (*Moravian Society*). [i]

Hildesheim (*Prussia*).

4387. Verein für Kunde der Natur und der Kunst im Fürstenthum Hildesheim und in der Stadt Goslar (*Society of Natural Sciences and Arts in the Principality of Hildesheim and in the City of Goslar*).

Hohenheim (*Würtemberg*).

4389. Königlich-Würtembergische Land- und Forstwirthschaftliche Akademie (*Royal Academy of Agriculture and Forest Culture*). [i]

Hohenleuben (*Saxony*).

4391. Voigtländischer Alterthumsforschender Verein (*Voigtlandish Archæological Society*). [i]

Homburg-vor-der-Höhe (*Prussia*).

4393. Verein für Geschichte und Alterthumskunde (*Society of History and Archæology*).

Immenstadt (*Bavaria*).

[Alpen Landwirthschaftliche Versuchs-Station (*Experimental Agricultural Station*).]

Ingolstadt (*Bavaria*).

4395. Historischer Verein (*Historical Society*).

Insterburg (*Prussia*).

4397. Alterthums-Gesellschaft (*Historical Society*).
4399. Landwirthschaftlicher Central-Verein für Lithauen und Masuren (*Central Agricultural Society of Lithuania and Masuren*). [i]

Jauer (*Prussia*).

4401. Oekonomisch-Patriotische Gesellschaft für das Fürstenthum Schweidnitz und Jauer (*Economic-Patriotic Association of the Principality of Schweidnitz and Jauer*). [i]

Jena (*Saxe-Weimar*).

4403. Allgemeiner Deutscher Apotheker-Verein (*Universal German Apothecaries' Association*). [i]
4405. Anatomisches Institut der Universität (*Anatomical Institute of the University*).

Jena (*Saxe-Weimar*)—Continued.

4407. Geographische Gesellschaft für Thüringen (*Geographical Society of Thuringia*).

4409. Grossherzoglich-Sächsisches Mineralogisches Museum (*Grand Ducal Mineralogical Museum*).

4411. Jenaische Zeitschrift für Medicin und Naturwissenschaften (*Jena Gazette of Medical and Natural Sciences*).

4413. Landwirthschaftliche Institut (*Agricultural Institute*). [i]

4415. Medicinisch-Naturwissenschaftliche Gesellschaft (*Society of Medical and Natural Sciences*). [Transfers all books to the University Library.] [i]

4417. Pharmaceutisch-Naturwissenschaftlicher Verein (*Society of Pharmacy and Natural Sciences*). [i]

4419. Redaktion: "Archiv der Pharmacie" (*Archives of Pharmacy*). [i]

4421. Redaktion: "Zeitschrift für Deutsche Landwirthe" (*Journal of German Agriculturists*). [i]

4423. Statistisches Bureau der Vereinigten Thüringischen Staaten (*Statistical Bureau of the United Thuringian States*). [i]

4425. Thüringer Fischerei-Verein (*Thuringian Fishery Association*). [i]

4427. Universitäts-Bibliothek (*University Library*). [i]

4429. Verein für Thüringische Geschichte und Alterthumskunde (*Society of Thuringian History and Archæology*). [i]

Kahla (*Saxe-Altenburg*).

4431. Geschichts- und Alterthumsforschender-Verein zu Kahla und Roda (*Kahla and Roda Society of History and Archæology*).

Kaiserslautern (*Bavaria*).

4433. Verein pflälzischer Aerzte (*Association of Physicians of the Palatinate*).

Karlsruhe (*Baden*).

4435. Allgemeiner Landes-Verein der Badischen Aerzte (*General Association of the Physicians of Baden*).

4437. Badische Geographische Gesellschaft (*Baden Geographical Society*).

4439. "Botanischer Jahresbericht" (*Botanical Annual*).

4441. Central-Bureau für Meteorologie und Hydrographie (*Central Bureau of Meteorology and Hydrography*). [i]

4443. Gewerbe-Verein (*Polytechnical Society*). [i]

4445. Grossherzoglich-Badisches Conservatorium der Alterthümer (*Baden Grand Ducal Conservatory of Antiquities*). [i]

Karlsruhe (*Baden*)—Continued.

4447. Grossherzoglich-Badisches Ministerium des Aeusseren (*Baden Grand Ducal Foreign Office*).
4449. Grossherzoglich-Badisches Ministerium für Justiz, Kultus, und Unterricht (*Baden Grand Ducal Department of Justice, Worship, and Education*).
4451. Grossherzoglich-Badische Polytechnische Schule (*Baden Grand Ducal Polytechnic School*). [i]
4453. Grossherzoglich-Badische Regierung (*Baden Grand Ducal Government*). [i]
4455. Grossherzoglich-Badisches Statistisches Bureau des Handels-Ministeriums (*Baden Grand Ducal Statistical Bureau of the Department of Commerce*). [i]
4457. Grossherzoglich - Badisches Topographisches Bureau (*Grand Ducal Topographic Bureau*).
4459. Grossherzogliche Central-Stelle für die Landwirthschaft (*Grand Ducal Bureau of Agriculture*). [i]
4461. Grossherzogliches Gymnasium (*Grand Ducal Gymnasium*). [i]
4463. Grossherzogliche Hof- und Landes-Bibliothek (*Grand Ducal and National Library*). [iii]
4465. Handels-Kammer (*Chamber of Commerce*). [i]
[Meteorologische Office. (See Central-Bureau für Meteorology, etc.)]
4467. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]
4469. Ober Direction der Wasser- und Strassen-Bauten (*Department of Public Works*).
4471. Sternwarte (*Observatory*). [i]
4473. Verein Badischer Thierärzte (*Baden Society of Veterinary Surgeons*).
4475. Wissenschaftlicher Prediger-Verein der Evangelischen Geistlichkeit Badens (*Scientific Society of Evangelic Ministers*).
4477. "Zeitschrift für Wissenschaftliche Geographie" (*Journal of Scientific Geography*).

Kassel (*Prussia*).

4479. "Botanisches Central-Blatt" (*Botanical Journal*).
4481. Kasseler Geometer-Verein (*Surveyors' Society*).
4483. Landwirthschaftlicher Central-Verein (*Central Agricultural Association*). [Transfers all books to the Ständische Landes-Bibliothek.]
4485. "Malacozoologische Blätter" (*Malacological Journal*). [i]
4487. "Paleontographica" (*Paleontographical Journal*).
4489. Ständische Landes-Bibliothek (*National Library*). [iii]

Kassel (*Prussia*)—Continued.

4491. Verein für Hessische Geschichte und Landeskunde (*Society of Hessian History and Geography*). [i]
4493. Verein für Naturkunde (*Natural History Society*). [i]

Kiel (*Prussia*).

4495. "Astronomische Nachrichten" (*Astronomical News*).
4497. Deutscher Samariter-Verein (*German Samaritan Association*).
4501. Gesellschaft für Schleswig-Holstein-Lauenburgische Geschichte (*Society for the History of Sleswick-Holstein-Lauenburg*). [i]
4503. Gesellschaft für Kieler Stadtgeschichte (*Local Historical Society*).
4505. Königliche Sternwarte (*Royal Observatory*). [i]
4507. Ministerial-Kommission zur wissenschaftlichen Untersuchung der Deutschen Meere (*Ministerial Commission for the Scientific Exploration of the German Seas*). [i]
4509. Naturwissenschaftlicher Verein für Schleswig-Holstein (*Sleswick-Holstein Society of Natural Sciences*). [i]
4511. Provinzial Blinden-Anstalt für Schleswig-Holstein (*Sleswick-Holstein Institution for the Blind*). [i]
4513. Redaktion: "Schulzeitung" (*School Gazette*). [i]
4515. Schleswig-Holsteinscher Landwirthschaftlicher General-Verein (*Sleswick-Holstein Agricultural Association*). [i]
4517. Schleswig-Holsteinsches Museum vaterländischer Alterthümer (*Sleswick-Holstein Museum of National Antiquities*). [i]
4519. Universitäts-Bibliothek (*University Library*). [iii]
4521. Zoologisches Institut der Universität (*Zoölogical Institute of the University*). [i]
4523. Verein Schleswig-Holsteinscher Aerzte (*Physicians' Association of Sleswick-Holstein*).
4525. Verein für Geographie und Naturwissenschaften (*Association of Geography and Natural Sciences*).

Klausthal (*Prussia*).

4527. Berg-Akademie (*Mining Academy*). [i]
[Naturwissenschaftlicher Verein. (See Berg- und Hüttenmännischer Verein.)]
4529. Berg- und Hüttenmännischer Verein "Maja" [formerly Naturwissenschaftlicher Verein] (*Mining Society "Maja"*). [i]

Koblenz (*Prussia*).

4531. Naturhistorischer Verein (*Natural History Society*). [i]

Koburg (*Saxe-Coburg-Gotha*).

4533. Deutscher Geometer-Verein (*German Surveyors' Society*).
4535. Anthropologischer Verein (*Anthropological Society*).
4537. Kunst- und Gewerbe-Verein (*Society for Art and Trade*). [i]
[Verein für Naturkunde im Herzogthum Sachsen (*Society of Natural Sciences in the Duchy of Saxe-Coburg-Gotha*). (Defunct.)]
4539. Verein für Wetterkunde (*Meteorological Society*).

Köln (*Prussia*).

4541. Gesellschaft für Rheinische Geschichtskunde (*Society for Rhenish History*).
[Historischer Verein für den Niederrhein (*Historical Society of the Lower Rhine*). (Defunct.)]
4545. Redaktion: "Correspondenz-Blatt des Niederrheinischen Vereins für Oeffentliche Gesundheitspflege" (*Organ of the Nether-Rhenish Society of Public Hygiene*). [i]
4547. Redaktion: "Wochenschrift für Astronomie und Meteorologie" (*Weekly Journal of Astronomy and Meteorology*).

Königsberg-in-Preussen (*Prussia*).

4549. Alterthums-Gesellschaft "Prussia" (*Archæological Society "Prussia"*).
4551. Fisherei-Verein für die Provinz Preussen (*Fishery Association of the Province of Prussia*). [i]
4553. Königliche [Ostpreussische] Physikalisch-Oekonomische Gesellschaft (*Royal Physico-Economical Society*). [iii]
4555. Ostpreussischer Landwirthschaftlicher Central-Verein (*Central Agricultural Society of East Prussia*). [i]
4557. Preussischer Provinzial-Verein für den Blinden-Unterricht (*Prussian Provincial Society for the Instruction of the Blind*). [i]
4559. Redaktion: "Land- und Forstwirthschaftliche Zeitung" (*Agricultural and Forestry Gazette*).
4561. Universitäts-Bibliothek (*University Library*). [iii]
4563. Universitäts-Sternwarte (*University Observatory*). [i]
4565. Verein für die Geschichte von Ost und West Preussen (*Association for the History of East and West Prussia*).

Konstanz (*Baden*).

4567. Münsterbau-Verein (*Cathedral Building Society.*)
4569. Wessenbergische Stadt-Bibliothek (*Wessenberg City Library*). [i]

Kórnik (*near Posen, Prussia*).

4571. Biblioteca Kórnięka (*Kórnick Library*). [iii]

Lahr (*Baden*).

4573. "Zeitschrift für Geographie" (*Geographical Gazette*).

Landshut (*Bavaria*).
4575. Botanischer Verein (*Botanical Society*). [i]
4577. Historischer Verein für Niederbaiern (*Historical Society of Lower Bavaria*). [i]

Lauingen (*Bavaria*).
4579. Verein für Naturwissenschaftliche Zwecke (*Society of Natural Sciences*). [i]

Leipzig (*Saxony*).
4581. Dr. Felix Flügel [39 Sidonien Strasse] (Agent of the Smithsonian Institution). [iii]
4583. Astronomische Gesellschaft (*Astronomical Society*). [i]
4585. Börsen-Verein der Deutschen Buchhändler (*Exchange Society of the German Booksellers*).
4587. F. A. Brockhaus Verlags-Buchhandlung (*F. A. Brockhaus' Publishing House*). [iii]
4589. Central-Museum für Völkerkunde (*Central Museum of Ethnology*). [i]
4591. Central-Verein Deutscher Zahnärzte (*Central Association of German Dentists*). [i]
4593. Central-Verein für Homöopathische Aerzte Deutschland (*Central Society of Homœopathic Physicians*).
4595. Deutsche Gesellschaft zur Erforschung vaterländischer Sprache und Alterthümer (*Society for the Exploration of the German Language and Archæology*).
[Deutsche Morgenländische Gesellschaft. (To be addressed in Halle a. d. S.]
4597. Deutscher und Oesterreichischer Alpen-Verein, Section Leipzig (*Leipsic Section, German and Austrian Alpine Association*).
4599. Deutscher Verein zur Erforschung Palestina's (*German Society for the Exploration of Palestine*).
4601. Wilhelm Engelmann Verlags-Buchhandlung (*William Engelmann's Publishing House*). [iii]
4603. Fürstlich Jablonowski'sche Gesellschaft der Wissenschaften (*Prince of Jablonowski's Society of Sciences*). [i]
4605. Geologische Landes-Untersuchung des Königreichs Sachsen (*Geological Exploration of the Kingdom of Saxony*). [i]
4607. Gesellschaft für Geburtshülfe (*Society of Obstetrics*).
4609. Handels-Kammer (*Chamber of Commerce*). [i]
4611. Königlich-Sächsische Gesellschaft der Wissenschaften (*Royal Saxon Society of Sciences*). [iii]
4613. Landwirthschaftlicher Kreis-Verein (*Agricultural Society*). [i]

Leipzig (*Saxony*)—Continued.

4615. Landwirthschaftliche Institut der Universität (*Agricultural Institute of the University*). [i]

[Leipziger Zweigverein der Gesellschaft für Verbreitung von Volksbildung (*Leipsic Branch of the Society for the Diffusion of the Knowledge among People*). (See Verein für Volkswohl.)]

4619. Medicinische Gesellschaft (*Medical Society*). [i]

[Meteorologisches Institut. (Transferred to Chemnitz.)]

4621. Mineralogisches Museum (*Mineralogical Museum*). [i]

4623. Naturforschende Gesellschaft (*Naturalists' Society*). [i]

4625. Oeffentliche Handels-Lehr-Anstalt (*Public Commercial School*). [i]

4627. Physiologische Anstalt (*Physiological Institute*). [i]

4629. Polytechnische Gesellschaft (*Polytechnical Society*). [i]

4631. Redaktion: "Aerztliches Vereins-Blatt für Deutschland" (*Journal of Medical Societies in Germany*). [i]

4633. Redaktion: "Annalen der Chemie und Pharmacie" (*Annals of Chemistry and Pharmacy*).

4635. Redaktion: "Archiv der Mathematik und Physik" (*Archives of Mathematics and Physics*). [i]

4637. Redaktion: "Archiv für Anatomie, Physiologie und wissenschaftliche Medicin" [Veit u. Co.] (*Archives of Anatomy, Physiology, and Medical Sciences*). [i]

4639. Redaktion: "Archiv für Sächsische Geschichte" (*Archives of Saxon History*).

4641. Redaktion: "Aus Allen Welttheilen" ("*From all Parts of the Globe*").

4643. Redaktion: "Berg- und Hüttenmännische Zeitung" (*Mining and Smelting Journal*).

4645. Redaktion: "Deutsche Vierteljahrsschrift für Zahnheilkunde" (*German Quarterly Journal of Dentistry*).

4647. Redaktion: "Deutsches Archiv für Klinische Medicin" (*German Archives of Clinical Medicine*). [i]

4649. Redaction: "Gaea, Natur und Leben" (*Gæa, Nature and Life*).

4651. Redaktion: "Internationale Zeitschrift für Allgemeine Sprachwissenschaft" (*International Gazette of Linguistics*).

4653. Redaktion: "Jahrbücher für Wissenschaftliche Botanik" (*Annals of Scientific Botany*). [i]

4655. Redaktion: "Kosmos," Zeitschrift für Naturwissenschaft (*Kosmos, Journal of Natural Sciences*).

4657. Redaktion: "Magazin für die Literatur des Auslands" (*Magazine for the Literature of Foreign Countries*). [i]

4659. Redaktion: "Morphologisches Jahrbuch" (*Morphological Annual*).

Leipzig (*Saxony*)—Continued.

4661. Redaktion: "Neue Deutsche Gewerbe-Zeitung" (*New German Industrial Gazette*).

4663. Redaktion: "Neue Jahrbücher für Philologie und Pedagogik" (*New Annual of Philology and Pedagogy*).

4665. Redaktion: "Poggendorff's Beiblätter zu den Annalen der Physik und Chemie" (*Poggendorff's Supplements to the Annals of Physics and Chemistry*). [i]

[Redaktion: "Polytechnisches Central-Blatt" (*Polytechnic Central Gazette*). (Discontinued.)]

4667. Redaktion: "Repertorium der Technischen, Mathematischen, und Naturwissenschaftlichen Literatur" (*Repertory of the Technical, Mathematical, and Natural Science Literature*).

4669. Redaktion: "Zeitschrift für Ægyptische Sprach- und Alterthumskunde" (*Journal of Egyptian Linguistics and Archæology*).

4671. Redaktion: "Zeitschrift für Krystallographie und Mineralogie" (*Journal of Crystallography and Mineralogy*).

4673. Redaktion: "Zeitschrift für wissenschaftliche Zoologie" (*Journal of Scientific Zoology*). [i]

4675. Stadt-Bibliothek (*City Library*). [iii]

4677. Sächsischer Ingenieur- und Architekten-Verein (*Society of Saxon Engineers and Architects*).

4679. Städtische Real-Schule (*City "Real" School*). [i]

4681. Städtisches Gymnasium (*City Gymnasium*). [i]

4683. Statistisches Bureau (*Statistical Bureau*). [i]

4685. Taubstummen-Anstalt (*Institute for the Deaf and Dumb*). [i]

4687. Universitäts-Bibliothek (*University Library*). [Does not want such publications as are sent to the Royal Saxon Society of Sciences.]

4689. Universitäts-Sternwarte (*University Observatory*). [Transfers books to the Royal Saxon Meteorological Institute.]

4691. Verein der Buchhändler (*Booksellers' Association*).

4693. Verein für Anthropologie (*Anthropological Society*). [i]

4695. Verein für Erdkunde (*Geographical Society*). [i]

4697. Verein für die Geschichte Leipzig's (*Society for the History of Leipsic*). [i]

4699. Verein für Volkskindergärten (*Society of Kindergarten*). [i]

4700. Verein für Volkswohl (*Society for the Welfare of the People*). [Formerly: Leipziger Zweigverein der Gesellschaft für Verbreitung von Volksbildung.] [i]

4701. Zoologischer Anzeiger (*Zoological Journal*). [i]

Leisnig.

4703. Geschichts- und Alterthums-Verein (*Historical and Archæological Society*). [i]

Liegnitz (*Prussia*).

4705. Landwirthschaftlicher Verein (*Agricultural Society*). [i]

Lindau (*Bavaria*).

[Verein für die Geschichte des Bodensees und seiner Umgebung. (See Friedrichshafen.)]

Lübeck.

4707. Geographische Gesellschaft (*Geographical Society*).

4709. Gesellschaft zur Beförderung gemeinnütziger Thätigkeit (*Society for the Advancement of Useful Industry*). [i]

4711. Hansischer Geschichts-Verein (*Hanse Historical Society*).

4713. Naturhistorisches Museum (*Museum of Natural History*). [i]

4715. Stadt-Bibliothek (*City Library*). [i]

4717. Verein für Lübeckische Geschichte und Alterthumskunde (*Society of Lübeck History and Archæology*). [i]

Lüneburg (*Prussia*).

[Alterthums-Verein. (Dissolved.)]

4719. Museum-Verein (*Museum Society*). [i]

4721. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]

Luxembourg.

4723. Institut Luxembourgeois, Section Historique (*Institute of Luxemburg, Historical Division*). [i]

4725. Institut Luxembourgeois, Section des Sciences Naturelles et Mathématiques (*Luxemburg Institute, Division of Natural Sciences and Mathematics*). [i]

4727. Société de Botanique du Grand-Duché de Luxembourg (*Botanical Society of the Grand Duchy of Luxemburg*). [i]

Magdeburg (*Prussia*).

4729. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]

4731. Verein für die Geschichte und Alterthumskunde des Herzogthums und Erzstifts Magdeburg (*Magdeburg Society of History and Archæology*).

4733. Verein für Landwirthschaftliche Wetterkunde in der Provinz Sachsen, den Sächsischen Grossherzog-, Herzog- und Fürstenthümern, den Herzogthümern Anhalt und Braunschweig, und der Uckermark (*Association of Agricultural Meteorology, &c.*).

4735. Verein für Oeffentliche Gesundheitspflege (*Association of Public Hygiene*).

Mainz (*Hesse*).

4737. Grossherzogliche Handels-Kammer (*Grand Ducal Chamber of Commerce*). [i]

4739. Verein zur Erforschung der Rheinischen Geschichte und Alterthümer (*Society for Research in Rhenish History and Archæology*). [i]

Mannheim (*Baden*).
4741. Grossherzogliches Gymnasium (*Grand Ducal Gymnasium*). [i]
[Sternwarte (*Observatory*). (In Karlsruhe.)]
4743. Verein für Naturkunde (*Society of Natural Sciences*). [i]

Marburg (*Prussia*).
4745. Gesellschaft zur Beförderung der gesammten Naturwissenschaften (*Society for the Advancement of Natural Sciences*). [iii]
4746. Sternwarte (*Observatory*).
4747. Universitäts-Bibliothek (*University Library*). [iii]
4749. Verein Kurhessischer Thierärzte (*Society of Veterinary Surgeons*).

Marienburg (*Prussia*).
4751. Historischer Verein für den Regierungs-Bezirk Marienwerder (*Historical Association for the District of Marienwerder*).
4753. Taubstummen-Anstalt (*Institution for the Deaf and Dumb*).

Meersburg (*Baden*).
4755. Grossherzoglich-Badische Allgemeine Taubstummen-Anstalt (*Grand Ducal Institute for the Deaf and Dumb*). [i]

Meiningen (*Saxe-Meiningen*).
4757. Hennebergischer Alterthumsforschender Verein (*Henneberg Archæological Society*). [i]
4759. Herzogliche Schloss-Bibliothek (*Ducal Library*).
4761. Herzogliches Statistisches Bureau (*Ducal Statistical Bureau*).
4763. Landwirthschaftlicher Verein (*Agricultural Society*).
4765. Naturforschender-Verein (*Naturalists' Society*).
4767. Stadt-Bibliothek (*City Library*).
4769. Verein für Pomologie und Gartenbau (*Pomological and Horticultural Society*). [i]

Meissen (*Saxony*).
4771. Gesellschaft "Isis" ("*Isis*" *Society*). [iii]
4773. Verein für die Geschichte der Stadt Meissen (*Society for the History of the City of Meissen*).

Metz (*Lorraine*).
4775. Académie de Metz (*Academy of Metz*). [iii]
4777. Bibliothèque de Metz (*City Library*).
4779. Société d'Archéologie et d'Histoire [formerly at Briey, France] (*Archæological and Historical Society*). [i]

Metz (*Lorraine*)—Continued.

4781. Société d'Histoire Naturelle de Metz (*Natural History Society of Metz*). [i]

4783. Société des Sciences Médicales du Département de la Moselle (*Society of Medical Sciences of the Department of the Moselle*). [i]

4785. Verein für Erdkunde (*Geographical Society*). [i]

Mölln in Lauenburg (*Prussia*).

4787. Verein für die Geschichte des Herzogthums Lauenburg (*Society for the History of the Duchy of Lauenburg*).

Mülhausen (*Alsace*).

4789. Société Industrielle (*Industrial Society*). [i]

Müncheberg (*Prussia*).

4791. Verein für Heimathskunde (*Historical Society*).

München (*Bavaria*).

4793. Alterthums-Verein (*Archæological Society*).

4795. Baierische Gartenbau-Gesellschaft (*Bavarian Horticultural Society*). [i]

[Deutsche Gesellschaft für Anthropologie, &c. (See Münchener Gesellschaft, &c.)]

4797. Baierische Numismatische Gesellschaft (*Bavarian Numismatic Society*).

4799. Geographische Gesellschaft (*Geographical Society*). [i]

4801. Haupt-Conservatorium der Armeè: Central-Bibliothek des Heeres (*Central Library of the Army*). [i]

4803. Historischer Verein für Oberbaiern (*Historical Society of Upper Bavaria*). [i]

4805. Königlich-Baierische Akademie der Wissenschaften (*Royal Bavarian Academy of Sciences*). [iii]

4807. Königlich-Baierisches Statistisches Bureau (*Royal Bavarian Statistical Bureau*). [i]

4811. Königlich-Baierische Meteorologische Central-Anstalt (*Royal Bavarian Central Meteorological Bureau*). [i]

4813. Königlich-Baierische Technische Hochschule (*Royal Bavarian Technical High School*). [i]

4815. Königlicher Botanischer Garten (*Royal Botanical Garden*). [i]

4817. Königlicher General-Quartier-Meister-Stab (*Royal Quartermaster-General's Department*). [i]

4819. Königliche Hof- und Staats-Bibliothek (*Royal and State Library*). [iii]

4821. Königliches Staats-Herbarium (*Royal Herbarium*). [i]

4823. Königliches Staats-Ministerium (*Royal Department of State*). [Deposits books with Royal Library.]

München (*Bavaria*)—Continued.

4825. Königliche Sternwarte (*Royal Observatory*). [i]

4827. Königliche Taubstummen-Anstalt (*Royal Institution for the Deaf and Dumb*). [i]

4829. Königliches Topographisches Bureau (*Royal Topographical Bureau*).

4831. Landwirthschaftlicher Verein (*Agricultural Society*). [i]

[Meteorologisches System. (See Königlich-Baierische Meteorologische Central-Anstalt.)]

4833. Ministerium des Oeffentlichen Unterrichts (*Department of Public Instruction*). [Deposits all donations with the Royal Library.] [i]

4835. Münchener Gesellschaft für Anthropologie, Ethnologie, und Urgeschichte (*Munich Society of Anthropology, Ethnology, and Primitive History*). [i]

4837. Polytechnischer Verein (*Polytechnic Society*). [i]

4841. Redaktion: "Das Ausland". [Formerly in Stuttgart.] [i]

4843. Redaktion: "Baierisches Industrie- und Gewerbe-Blatt" (*Bavarian Industrial Gazette*).

4845. Redaktion: "Zeitschrift für Biologie" (*Biological Journal*). [i]

4847. Universitäts-Bibliothek (*University Library*). [iii]

Münden (*Prussia*).

4849. Königlich-Preussische Forst-Akademie (*Royal Prussian Forest Academy*). [i]

Münster (*Prussia*).

4851. Landwirthschaftlicher Provinzial-Verein für Westfalen und Lippe (*Provincial Agricultural Society for Westphalia and Lippe*). [i]

4853. Polytechnischer Verein (*Polytechnic Society*).

4855. Provinzial-Verein für Wissenschaft und Kunst (*Provincial Society of Science and Art*). [i]

4857. Sternwarte (*Observatory*). [i]

4859. Verein für die Geschichte und Alterthümer Westphalens (*Society of Westphalian History and Antiquities*). [i]

Neisse (*Prussia*).

4861. Katholisches Gymnasium (*Catholic Gymnasium*). [i]

[Philomatische Gesellschaft. (See Wissenschaftliche Gesellschaft.)]

4863. Realschule ("*Real*" *School*). [i]

4865. Wissenschaftliche Gesellschaft "Philomatie" ("*Philomatie*" *Scientific Society*). [i]

Neu Brandenburg (*Mecklenburg*).

[Verein der Freunde der Naturgeschichte in Mecklenburg. (See Güstrow.)]

Neustadt (*Prussia*).

["Pollichia." (See Dürkheim.)]

Neustadt-Eberswalde (*Prussia*).

4867. Königliche Forst-Akademie (*Royal Forest Academy*).

Nordhausen (*Prussia*).

4869. Wissenschaftlicher Verein (*Scientific Society*). [i]

Nürnberg (*Bavaria*).

4871. Baierisches Gewerbe-Museum (*Bavarian Polytechnic Museum*). [i]
4873. Germanisches Museum (*Germanian Museum*). [i]
4875. Gewerbe-Verein (*Polytechnic Society*). [i]
4877. Historischer Verein (*Historical Society*). [i]
4879. Naturhistorische Gesellschaft (*Natural History Society*). [iii]

Offenbach (*Baden*).

4881. Grossherzogliche Handels-Kammer (*Grand Ducal Chamber of Commerce*). [i]
4883. Verein für Naturkunde (*Society of Natural Sciences.*) [i]

Oldenburg (*Oldenburg*).

4885. Gewerbe-und Handels-Verein (*Society of Trade and Commerce*). [i]
4887. Grossherzogliche Bibliothek (*Grand Ducal Library*). [iii]

Osnabrück (*Prussia*).

4889. Historischer Verein (*Historical Society*). [i]
4891. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]

Passau (*Bavaria*).

4893. Naturhistorischer Verein (*Natural History Society*). [i]
4895. Praktische Gartenbau-Gesellschaft in Baiern (*Practical Horticultural Society of Bavaria*). [i]

Plauen (*Saxony*).

4897. Gymnasium und Realschule (*Gymnasium and "Real" School*). [i]
4899. Verein für Natur-und Heilkunde (*Society of Natural and Medical Sciences*). [i]

Posen (*Prussia*).

4901. Gesellschaft der Freunde der Wissenschaften (*Society of the Friends of Science*).

Posen (*Prussia*)—Continued.

4903. Historische Gesellschaft für die Provinz Posen (*Historical Society of the Province of Posen*).

4905. Landwirthschaftlicher Provinzial-Verein (*Agricultural Districts' Society*). [i]

4907. Naturwissenschaftlicher Verein (*Society of Natural Sciences*). [i]

4909. Städtische Realschule (*City* "Real" *School*). [i]

Potsdam (*Prussia*).

4911. Astro-Physikalisches Observatorium (*Astro-Physical Observatory*). [i]

4913. Landwirthschaftlicher Provincial-Verein für die Mark Brandenburg und die Nieder Lausitz (*Agricultural Society for the Province of Brandenburg and Nether Lusatia*). [May also be addressed at Prenzlau.] [i]

4915. Verein zur Beförderung des Seidenbaues in der Mark Brandenburg und der Nieder Lausitz (*Society for the Promotion of the Silk-Worm Culture in the Province of Brandenburg and in Nether Lusatia*). [Transfer their books to the Landwirthschaftliche Provincial-Verein.]

Proskau (*Prussia*).

4917. Landwirthschaftliche Akademie (*Agricultural Academy*). [i]

Quedlinburg (*Prussia*).

4919. Allgemeine Berg- und Hüttenmännische Zeitung (*Mining and Smelting Journal*).

Rastadt (*Baden*).

4921. Grossherzogliches Gymnasium (*Grand Ducal Gymnasium*). [i]

Ravensburg (*Würtemberg*).

4923. Deutscher Pomologen-Verein (*German Pomological Society*). [i]

Regensburg (*Bavaria*).

4925. Historischer Verein für die Oberpfalz (*Historical Society of the Upper Palatinate*). [i]

4927. Königlich-Baierischer Apotheker-Verein (*Royal Bavarian Apothecaries Association*). [i]

4929. Königliche Baierische Botanische Gesellschaft (*Royal Bavarian Botanical Society*). [i]

4931. Königliche Baierische Gesellschaft der Wissenschaften (*Royal Bavarian Society of Sciences*).

4933. Zoologisch-Mineralogischer Verein (*Zoological Mineralogical Association*). [i]

Reichenbach (*Saxony*).
4935. Voigtländischer Verein für Naturkunde (*Voigtland Society of Natural Science*). [i]

Reutlingen (*Würtemberg*).
4937. Pomologisches Institut (*Pomological Institute*). [i]

Roda (*Saxe-Altenburg*).
4939. Thüringer Fischerei-Verein (*Thuringian Fishery Society*). [i]

Rostock (*Mecklenburg*).
[Mecklenburgischer Patriotischer Verein (*Mecklenburg Patriotic Society*).]
4943. Universitäts-Bibliothek (*University Library*). [iii]

Schwäbisch Hall. (See Hall.)

Schwerin (*Mecklenburg*).
[Grossherzogliche Landes-Vermessungs-Kommission. Dissolved. Books transferred to Grossherzogliche Regierungs-Bibliothek.]
4945. Grossherzogliche Regierungs-Bibliothek (*Grand Ducal Government Library*). [i]
4947. Grossherzogliches Statistisches Bureau (*Grand Ducal Statistical Bureau*). [i]
4949. Verein für Mecklenburgische Geschichte und Alterthumskunde (*Society for the History and Archæology of Mecklenburg*]. [i]

Siegmaringen (*Prussia*).
4951. Central-Stelle des Vereins zur Beförderung der Landwirthschaft und der Gewerbe in Hohenzollern (*Society for the Promotion of Agriculture and the Trades in Hohenzollern*). [i]

Sondershausen (*Schwarzburg*).
4953. Botanischer Verein für das Nördliche Thüringen (*Botanical Society in Northern Thuringia*).
4955. Fürstliche Realschule ("*Real" School*). [i]
4957. Fürstliches Gymnasium (*Gymnasium*). [i]
4959. Fürstlich Schwarzburgische Ministerial-Canzlei (*Chancelry of the Ministry*).
4961. Verein zür Beförderung der Landwirthschaft (*Society for the Promotion of Agriculture*). [i]

Speier (*Bavaria*).
4963. Historischer Verein für Rheinbaiern (*Historical Society of Rhenish Bavaria*). [i]

Stade (*Prussia*).
4965. Verein für Geschichte und Alterthümer (*Historical and Archæological Society*). [i]

Stettin (*Prussia*).

4967. Entomologischer Verein (*Entomological Society*). [iii]

4969. Gesellschaft für Pommersche Geschichte und Alterthumskunde (*Society of Pommeranian History and Archæology*). [i]

4971. Redaktion: "Deutsche Fischerei-Zeitung" (*German Fisheries Gazette*).

Strassburg (*Alsace*).

4973. Bibliothèque Municipale (*Municipal Library*). [iii]

4975. Kaiserliche Universitäts- und Landes-Bibliothek (*Imperial University and National Library*). [iii]

4977. Kommission für die Geologische Landes-Untersuchung von Elsass-Lothringen (*Geological Commission of Alsace-Lorraine*).

4979. Musée d'Histoire Naturelle (*Natural History Museum*). [i]

4981. Société pour la Conservation des Monuments historiques d'Alsace (*Society for the Preservation of Historical Monuments of Alsace*). [i]

4983. Société des Sciences, Agriculture et Arts de la Basse Alsace (*Society of Sciences, Agriculture, and Arts, of Lower Alsace*). [iii]

[Société des Sciences Naturelles de Strasbourg. Dissolved.]

4985. Sternwarte der Kaiserlichen Universität (*Observatory of the Imperial University*). [i]

4987. Zoologisch-Zootomisches Institut der Universität (*Zootomical Institute of the University*).

Strelitz (*Mecklenburg*).

[Verein der Freunde der Naturgeschichte (*Society of the Friends of Natural History*). (See Güstrow.)]

Stuttgart (*Würtemberg*).

4989. Seine Majestät der König von Würtemberg (*His Majesty the King of Würtemberg*). [i]

[American Public Library. Transferred to Frankfurt a. M.]

4991. Anthropologische Gesellschaft (*Anthropological Society*). [i]

4993. Central-Leitung des Wohlthätigkeits-Vereins für Würtemberg (*Central Board of the Charitable Society of Würtemberg*). [i]

4995. Gartenbau-Gesellschaft "Flora" (*"Flora" Horticultural Society.*) [i]

4997. Gesellschaft für die Weinverbesserung in Würtemberg (*Society for the Improvement of Wine-culture in Würtemberg*). [i]

4999. Gewerbe-Verein (*Polytechnic Society*). [i]

Stuttgart (*Würtemberg*)—Continued.

5001. Heilgymnastisches Institut (*Movement-cure Institute*). [i]
5003. Königliche Central-Stelle für Gewerbe und Handel (*Royal Central Bureau of Trade and Commerce*). [i]
5005. Königliche Central-Stelle für die Landwirthschaft (*Royal Central Bureau of Agriculture*). [i]
5007. Königliches Finanz-Ministerium (*Royal Finance Department*).
5009. Königliche Forst-Direction (*Royal Bureau of Forests*).
5011. Königliches Haus- und Staats-Archiv (*Royal and National Archives*). [i]
5013. Königliches Justiz-Ministerium (*Royal Department of Justice*).
5015. Königliches Ministerium der Auswärtigen Angelegenheiten (*Royal Foreign Office*).
5017. Königliches Ministerium des Innern (*Interior Department*).
5019. Königliches Ministerium des Kirchen- und Schulwesens (*Royal Department of Church and Education*).
5021. Königliche Oeffentliche Bibliothek (*Royal Public Library*). [iii]
5023. Königliches Polytechnikum (*Royal Polytechnic Institute*). [i]
[Königliches Staats-Archiv. (See Königliches Haus- und Staats-Archiv.)]
5025. Königliches Statistisches Landes Amt (*Royal Statistical Bureau*). [i]
[Redaktion: "Das Ausland"—in München.]
5027. Redaktion: "Kosmos" (*Kosmos*).
5029. Redaktion: "Polytechnisches Journal" (*Polytechnical Journal*).
5031. Redaktion: "Ueber Land und Meer."
5033. Stuttgarter Aerztlicher Verein (*Physicians' Society*). [i]
5035. Verein für vaterländische Naturkunde in Würtemberg (*Society of Natural History of Würtemberg*). [iii]
[Verein zur Förderung der Deutschen Cultur-Mission im Ausland (*Society for the Promotion of German Culture Abroad*). Dissolved.]
5037. Verein zur Fürsorge entlassener Strafgefangener (*Society for Providing for Discharged Prisoners*). [i]
5039. Würtembergischer Aerztlicher Verein (*Physicians' Society of Würtemberg*).
5041. Würtembergischer Alterthums-Verein (*Archæological Society of Würtemberg*). [i]
5043. Würtembergischer Gartenbau-Verein (*Horticultural Society of Würtemberg*). [i]

Stuttgart (*Würtemberg*)—Continued.

5045. Würtembergischer Thierärztlicher Verein (*Society of Veterinary Surgeons of Würtemberg*).
5047. Würtembergischer Thierschutz-Verein (*Würtemberg Society for the Protection of Animals*).

Tharand (*Saxony*).

[Königlich-Sächsische Akademie für Land und Forstwirthe (*Royal Agricultural and Forest Academy of Saxony.*)]

Thorn (*Prussia*).

5049. Copernicus Verein für Wissenschaft und Kunst (*Copernicus Society of Sciences and Arts*). [i]

Trier (*Prussia*).

5051. Gesellschaft für nützliche Forschungen (*Society of Useful Research*). [i]

Tübingen (*Würtemberg*).

5053. Chemisches Haupt-Laboratorium der Universität (*Chemical Laboratory of the University*).
5055. Königliche Universitäts-Bibliothek (*Royal University Library*). [iii]
5057. Landwirthschaftlicher Verein (*Agricultural Society*). [i]
5059. Redaktion: "Jahresbericht für Ophthalmologie" (*Annals of Ophthalmology*).
5061. Redaktion: "Zeitschrift für die gesammten Staats-Wissenschaften" (*Journal of Political Science*).

Ulm (*Würtemberg*).

5063. Naturwissenschaftliche Gesellschaft (*Society of Natural Sciences*). [i]
5065. Verein für Kunst und Alterthum in Oberschwaben (*Society of Art and Archæology in Upper Swabia*). [i]

Waren (*Mecklenburg*).

5067. Von Maltzan'sches Naturhistorisches Museum (*Von Maltzan Natural History Museum*). [i]

Weilburg (*Prussia*).

5069. Verein Nassauischer Aerzte (*Nassau Physicians' Society*). [i]

Weimar (*Saxe-Weimar*).

5071. Geographisches Institut (*Geographical Institute*). [i]
5073. Verein für Blumistik und Gartenbau (*Society of Floriculture and Horticulture*). [i]

Weinsberg (*Würtemberg*).

5075. Historischer Verein für das Würtembergische Franken (*Historical Society of Wurtemberg Franconia*). [i]

Wernigerode (*Prussia*).

5077. Gräfliche Oeffentliche Bibliothek (*Public Library*). [iii]
5079. Harz Verein für Geschichte und Alterthumskunde (*Hartz Society of History and Archæology*). [i]

Wiesbaden (*Prussia*).

5081. Gewerbe-Verein für Nassau (*Polytechnic Society of Nassau*). [i]
5083. Verein für Nassauische Geschichte und Alterthumskunde (*Society for the History and Archæology of Nassau*). [i]
5085. Verein für Naturkunde (*Society of Natural Sciences*). [iii]
5087. Verein Nassauischer Land- und Forstwirthe (*Society of Agriculturists and Foresters of Nassau*). [i]
5089. Zeitschrift für Analytische Chemie (*Journal of Analytical Chemistry*). [i]

Wilhelmshafen (*Prussia*).

5091. Marine Sternwarte (*Naval Observatory*). [i]

Worms (*Hesse*).

5093. Grossherzogliches Gymnasium (*Grand Ducal Gymnasium*). [i]
5095. Grossherzoglich Hessische Handels-Kammer (*Grand Ducal Chamber of Commerce*). [i]

Würzburg (*Bavaria*).

5097. Historischer Verein von Unterfranken und Aschaffenburg (*Historical Society of Lower Franconia and Aschaffenburg*). [i]
5099. Physikalisch-Medizinische Gesellschaft (*Physico- Medical Society*). [iii]
5101. Polytechnischer Central-Verein (*Central Polytechnic Society*). [i]
5103. Unterfränkischer Kreis-Fischerei-Verein (*Fishery Association of Lower Franconia*).
5105. Universitäts-Bibliothek (*Library of the University*). [iii]
5107. Zoologisch Zootomisches Institut der Universität (*Zootomical Institute of the University*).

Zittau (*Saxony*).

5109. Gewerbe-Verein (*Polytechnic Society*). [i]

Zweibrüken (*Bavaria*).

5111. Naturhistorischer Verein (*Natural History Society*). [i]

Zwickau (*Saxony*).

5113. Verein für Naturkunde (*Society of Natural Sciences*). [i]

GREAT BRITAIN AND IRELAND.

ENGLAND.

Alnwick.

5115. Berwickshire Naturalists' Club (care of James Hardy, Oldcambus, Cockburnspath, N. B.) [i]

Ashton-under-Lyne.

5117. Free Library. [i]

Aston (*Warwickshire*).

5119. Public Library Department. [i]

Aylesbury.

5121. Buckinghamshire Architectural and Archæological Society. [i]

Barnsley.

5123. Midland Institute of Mining, Civil, and Mechanical Engineers. [i]

Bath.

5125. Bath and West of England Society, and Southern Counties Association. [i]
5127. Bath Natural History and Antiquarian Field Club. [i]
5129. Bath Royal Literary and Philosophical Society. [i]
5131. Geological Record (care of Taylor & Francis, Publishers, Red Lion Court, Fleet Street, London, E. C.). [i]

Bedford.

5133. Bedfordshire Architectural and Archæological Society. [i]
5135. Journal of Microscopy and Natural Sciences.

Bidston.

5137. Liverpool Observatory (care of John Hartnup, Bidston, near Birkenhead). [i]

Birmingham.

5139. Birmingham Free Libraries (J. D. Mullins, Librarian, Radcliffe Place, Birmingham [Free Reference Library]). [iii]
5141. Birmingham Natural History and Microscopical Society (care of Mason College of Science). [i]
5143. Institute of Scientific Research (67 Broad Street). [i]
5145. Mason College of Science. [iii]
5147. The Midland Naturalist (care of E. W. Badger, Midland Counties Herald Office, Birmingham). [i]

Blackburn.

5149. Public Library and Museum. [i]

Boston (*Lincolnshire*).

5151. Workingmen's College. [i]

Brighton.

5153. Brighton Aquarium.
5155. Brighton and Sussex Natural History Society. [i]
5157. Free Public Library. [i]

Bristol.

5159. Bristol City Library. [i]
5161. Bristol Microscopical Society. [i]
5163. Bristol Museum and Library. [i]
5165. Bristol Naturalists' Society (care of A. Leipner, 47 Hampton Park, Clifton, near Bristol. [i]
5167. United States Consulate. [i]

[Institute for the Advancement of Sciences, Literature and Arts, identical with British Association for the Advancement of Science, London.]

Bury St. Edmunds.

5169. Suffolk Institute of Archæology and Natural History. [i]

Camborne (*Cornwall*).

[Miners' Association of Cornwall and Devon (formerly in Truro). (See Redruth.)]

Cambridge.

5171. Balfour Library, New Museum.
5173. Cambridge Antiquarian Society (care of S. S. Lewis, Librarian of Corpus Christi College). [i]
5175. Cambridge Free Library. [i]
5177. Cambridge Journal of Philology (care of Macmillan & Co., Bedford Street, Strand, London, W. C.). [i]
5179. Cambridge Observatory. [iii]
5181. Cambridge Philological Society. [i]
5183. Cambridge Philosophical Society. [iii]
5185. Corpus Christi College. [i]
5187. Fitzwilliam Museum. [i]
5189. Journal of Anatomy and Physiology (care of Macmillan & Co., Bedford Street, Strand, London).
5191. Museum of Zoology and Comparative Anatomy (Downing Street, Cambridge).
5193. New Archæological Museum of the University. [i]
5195. Oxford, Cambridge, and Dublin Messenger of Mathematics. [i]
5197. St. John College. [i]
5199. Trinity College. [i]
5201. University Library. [iii]
5203. Woodwardian Museum. [i]

Canterbury.

5205. East Kent Natural History Society (care of W. H. Housley, St. Stephen's Lodge, Canterbury, formerly in Dover). [i]

Cardiff.

5207. Naturalists' Society.
5209. University College.

Carlisle.

5211. Cumberland Association for the Advancement of Literature and Science.

Chatham.

5213. Royal Engineers' Institute. [i]

Chester.

5215. Chester and Cheshire Architectural and Archæological Society. [i]
5217. Chester Natural Science Society. [i]

Chesterfield.

5219. Chesterfield and Derbyshire Institute of Mining Engineers. [i]

Cirencester.

5221. Royal Agricultural College. [i]

Coteswold.

5223. Coteswold Naturalists' Field Club (care of Mr. Lucy, Gloucester). [i]

Coventry.

5225. Coventry and Warwickshire Pharmaceutical Association. [i]

Crowborough.

5227. Astronomical and Meteorological Observatory. [i]

Croyden.

5229. Croyden Microscopical Club. [i]

Darlington.

5231. Darlington Free Town Library.

Derby.

5233. Derbyshire County Lunatic Asylum. [i]

Devizes.

5235. Wiltshire Archæological and Natural History Society. [i]

Devonshire.

[Devonshire Association, &c., now in Exeter].

Doncaster.

5237. Yorkshire Institution for the Deaf and Dumb.] [i]

Dover.

[East Kent Natural History Society, now in Canterbury].

Dudley.

5239. Dudley and Midland Geological and Scientific Society and Field Club. [i]

Dumbarton.

5241. Free Public Library. [i]

Dulwich.

5243. Dulwich College Science Society.

Durham.

5245. Observatory. [i]

Eastbourne.

5247. Natural History Society (care of G. F. Chambers, F.R.A.S., Royal Astronomical Society, Burlington House, London, W.). [i]

Epping.

5249. The Epping Forest and County of Sussex Naturalists' Field Club. [i]

Eton.

5251. Eton College. [i]

Exeter.

5253. Devon and Exeter Albert Memorial Museum, School of Science and Art, and Free Library. [iii]
5255. Devon and Exeter Institution. [i]
5257. Devonshire Association for the Advancement of Science, Literature, and Art (care of Albert Memorial Museum).
5259. Teign Naturalists' Field Club (care of G. W. Ormerod, Teignmouth, Devon). [i]

Falmouth.

5261. The Observatory. [i]
5263. Royal Cornwall Polytechnic Society. [iii]

Farnborough Station (*Hants*).

5265. Royal Staff [Military] College. [i]

Greenwich.

5267. Astronomer Royal.
5269. Royal Naval College. [i]
5271. Royal Observatory. [iii]

Halifax.

5273. Bermerside Observatory, Skircoat. [i]
5275. Yorkshire Geological and Polytechnical Society (formerly in Leeds). [i]

Hereford.

5277. Woolhope Naturalists' Field Club (care of Arthur Thompson, 12 St. Nichol's Street, Hereford). [i]

Huddersfield.

5279. Yorkshire Archæological and Topographical Association. [i]

Hull.

5281. Hull Literary and Philosophical Society [Royal Institution]. [i]
5283. Subscription Library [Royal Institution]. [i]

Ipswich.

5285. Orwell Park Observatory. [i]

Isle of Man.

5287. Natural History and Antiquarian Society.

Keighley.

5289. Keighley Agricultural Society.

Kew.

5291. Royal Botanic Gardens. [i]
5293. Kew Observatory, (Richmond, Surrey). [iii]
5295. Meteorological Office.

Leeds.

5297. Conchological Society of Great Britain and Ireland. [i]
[Geological and Polytechnical Society, now in Halifax.]
5299. [Quarterly] Journal of Conchology. [i]
5301. Leeds Philosophical and Literary Society. [iii]
5303. Leeds Public Library. [i]
5305. Yorkshire College of Science. [i]
5307. Yorkshire Naturalists' Union. [i]

(NOTE.—All the Leeds packages might be put into one package and sent care of Taylor Bros., Journal of Conchology Office, St. Ann Street, top of Albion Street, Leeds.)

Leicester.

5309. Leicester Free Library (Wellington Street). [i]
5311. Leicester Literary and Philosophical Society. [i]
5313. Leicester Town Museum. [i]

Lewes.

5315. Sussex Archæological Society. [i]

Leyton (*Essex*).

5317. Private Observatory of Joseph G. Barclay. [i]

Liverpool.

5319. Anthropological Society (care of William Hitchwan, M. D., 144 Pythian Street, Low Hill, Liverpool).
5321. Architectural and Archæological Society. [i]
5323. Derby Museum. [i]
5325. Free Public Library, Museum, and Walker Gallery of Art of the town of Liverpool. [iii]
[Geological Magazine. (See London.)]
5327. Geological Society. [i]

Liverpool—Continued.

5329. Historic Society of Lancashire and Cheshire (care of Rupert Lane, Everton, Liverpool). [i]
5331. Literary and Philosophical Society (care of Royal Institution, Liverpool). [iii]
5333. Liverpool Art Club. [i]
5335. Liverpool Astronomical Society (care of Rev. T. E. Espin, Church Road, West Kirby, Birkenhead).
5337. Liverpool Chemists' Association. [i]
5339. Liverpool Engineers' Society. [i]
5341. Liverpool Geological Association—Free Public Library (William Brown Street). [i]
5343. Liverpool Naturalists' Field Club. [i]
5345. Liverpool Polytechnic Society. [i]
[Observatory. (See Bidston.)]
5347. Royal Institution. [i]

London.

5349. Her Majesty the Queen of Great Britain and Ireland. [iii]
5351. William Wesley (Agent of the Smithsonian Institution, 28 Essex Street, Strand). [i]
5353. Aborigines Protection Society (5 Tile Street, Chelsea, S. W.). [i]
5355. "Academy" (27 Chancery Lane). [i]
5357. Aëronautical Society of Great Britain (Maidenstone Hill, Blackheath, S. E.). [i]
5359. Agent General for Cape Colony (7 Albert Mansion, Victoria Street, S. W.). [i]
5361. Agent General for New South Wales (5 Westminster Chambers, Victoria Street, S. W.). [i]
5363. Agent General for New Zealand (7 Westminster Chambers, Victoria Street, S. W.). [i]
5365. Agent General for Queensland (Westminister Chambers, Victoria street, S. W.). [i]
5367. Agent General for Victoria (8 Victoria Chambers, Westminster, S. W.). [i]
5369. American Exchange in Europe (449 Strand, W. C.). [i]
5371. Annals and Magazine of Natural History (care of Taylor & Francis, Red Lion Court, Fleet Street, E. C.). [i]
5373. Anthropological Institute of Great Britain and Ireland (3 Hanover Square, W.). [iii]
5375. "Antiquary" (care of E. Stock, 62 Paternoster Row, E. C.). [i]
5377. Archæological Journal [organ of the Royal Archæological Institute] (Beford Mansions, Oxford Street, W.). [i]
5379. Architectural Publication Society (7 Whitehall Yard, S. W.). [i]

London—Continued.

5381. Art Union of London (Strand, W. C.). [i]
5383. Arundel Society (24 Old Bond Street, W.). [i]
5385. Astronomical Register (care of Rev. J. C. Jackson, 11 Angel Court, Throgmorton Street, E. C.). [i]
5387. "Athenæum" (20 Wellington Street, Strand, W. C.). [i]
5389. Athenæum Club (Pall Mall, S. W.). [iii]
5391. Birkbeck Literary and Scientific Institution (Bream's Building, Chancery Lane). [i]
5393. Board of Admiralty (Whitehall, S. W.). [iii]
5395. Board of Trade (Whitehall, S. W.). [i]
5397. "Bookseller" (care of Whittaker & Co., Ave Maria Lane, E. C.). [i]
5399. British Archæological Association (32 Sackville Street, Piccadilly, W.). [iii]
5401. British Association for the Advancement of Science (22 Albemarle Street). [iii]
5403. British Homœopathic Society (care of London Hospital, Great Ormond Street, Queen's Square, W. C.). [i]
5405. British Horological Institute (Northampton Square, E. C.). [i]
5407. British Journal of Photography. [i]
5409. British Medical Journal.
[British Meteorological Society. (See Royal Meteorological Society.)]
5411. British Museum (Great Russell Street, Bloomsbury, W. C.). [iii]
5413. British Museum, Natural History Division (Cromwell Road, South Kensington, S. W.).
5415. British Museum, Zoölogical Department.
[British Pharmaceutical Conference. (Has no library.)]
5417. Camden Society (25 Parliament Street, S. W.). [i]
5419. Chemical News, Boy Court, Ludgate Hill, E. C.). [i]
5421. Chemical Society of London (Burlington House, W.). [iii]
5423. Chemist and Druggist (44 Cannon Street, E. C.). [i]
5425. Central Chamber of Agriculture (21 Arundel Street, Strand).
5427. Chinese Customs Office (8 Storey's Gate, S. W.). [i]
[Chronological Institute. (See Horological Institute.)]
5429. Civil and Mechanical Engineers' Society (7 Westminster Chambers, Victoria Street, S. W.). [i]
5431. City and Guild of London Institute for the Advancement of Technical Education (Mercer's Hall, E. C.) [i]
5433. Civil Service Commission (Westminster, S. W.). [i]
5435. Clinical Society (63 Berners Street, Beford Street, W.). [i]

London—Continued.

5437. Cobden Club (care of Mr. Gowing, Cupper Park Road, Haverstock Hill, N. W.). [i]
5439. Committee on Solar Physics of the Lords of the Committee of Council on Education.
5441. Commissioners in Lunacy.
5443. "Contemporary Review" (care of Kegan, Paul & Co., Paternoster Row).
[Corps of Royal Engineers. (See Chatham.)]
5445. Crown Agents for the Colonies (Colonial Office Building, Downing Street). [i]
5447. "Daily News" Shipping and Mercantile Gazette (Bouverie Street, Fleet Street, E. C.).
5449. "Diplomatic Review" (7 Colbridge Road, Finsbury Park). [i]
5451. Duke of Northumberland (2 Grosvenor Place, S. W.). [iii]
5453. Early English Text Society (care of F. J. Furniwall, M. A., 3 St. George's Hill, Primrose Hill). [i]
5455. East India Association (20 Great George Street, Westminster, S. W.). [i]
5457. "Electrical Review" (22 Paternoster Row). [i]
5459. English and Foreign Electrotype Agency.
5461. English Mechanic and World of Science (31 Tavistock Street, Covent Garden). [i]
5463. Entomological Society (11 Chandos Street, Cavendish Square, W.). [iii]
5465. "Entomologist" (care of West & Newman, 58 Hatton Garden, E. C.). [i]
5467. "Entomologists' Monthly Magazine" (care of J. Van Voorst, 1 Paternoster Row, E. C.). [i]
5469. Epidemiological Society (11 Chandos Street, Cavendish Square, W.). [i]
[Ethnological Journal. Journal of the Anthropological Institute.]
[Ethnological Society. Identical with Anthropological Institute.]
5471. "European Mail" (care of Allen & Co., Waterloo Place, S. W.).
5473. "Fish Trades Gazette" (E. E. Hyde, 191 Fleet Street, E. C.).
5475. Fishery Department, Home Office (Whitehall, S. W.). [i]
5477. "Fishing Gazette" (Fetter Lane, E. C.). [i]
5479. Folk Lore Society (care of G. L. Gomme, 2 Park Villas, Londsdale Road, Barnes). [i]
5481. "Fortnightly Review" (care of Chapman & Hall, 12 Henrietta Street, Covent Garden, W. C.). [i]

London—Continued.

5483. Free Public Library (23 Great Smith Street, Westminster, S. W.). [i]

5485. Free Public Library in the office of the Commissioners of Patents for Inventions (Southampton Building, Chancery Lane, W. C.). [iii]

5487. Prof. W. H. Flower (Natural History Division, British Museum, South Kensington). [i]

5489. "Gardeners' Chronicle." [i]

[Geographical Magazine, now Journal of Royal Geographical Society.]

[Geological Association. Identical with Geologists' Association.]

5491. Geological Department, Home Office. [i]

5493. Geological Magazine (care of Trübner & Co., Ludgate Hill, E. C.). [i]

[Geological Record. (See Bath.)]

5495. Geological Society of London (Burlington House, W.). [iii]

5497. Geological Survey of Great Britain (Jermyn Street, S. W.). [i]

5499. Geologists' Association (University College, Gower Street, W. C.). [i]

[Great Seal Patent Office. (See Free Public Library in the office of the Commissioners of Patents of Inventions.)]

5501. Gresham College (91 Gresham Street, E. C.). [i]

5503. "Grevillea" (care of Williams & Norgate, 14 Henrietta Street, Covent Garden, W. C.). [i]

[Guy's Hospital Physical Society (9 St. Thomas Street, Borough, S. E.). (See Museum of Guy's Hospital.)]

5505. Hakluyt Society (care of Mr. Clark, 30 Sardinia Street, Lincoln's Inn, W. C.). [i]

5507. Hardwicke's Science Gossip (care of Chatto & Windus, Piccadilly, W.). [i]

5509. Harveian Medical Society of London (Stafford Rooms, Titcheborne Street, Edgeware Road, W.). [i]

5511. "Herald of Peace" (care of Passmore & Alabaster, 4 Paternoster Building, E. C.). [i]

5513. Historical Society (10 Chandos Street, Cavendish Square, W.).

5515. Home Department, Home Office (Whitehall, S. W.). [i]

5517. Howard Association (5 Bishopsgate Street Without, E. C.).

5519. Hudson's Bay Company's Library (1 Lime Street, E. C.). [i]

5521. Hunterian Society (care of London Institution, Finsbury Circus, E. C.). [i]

London—Continued.

5523. Hydrographic Office of the Admiralty (Whitehall, S.W.). [i]

[Imperial Museum for India and the Colonies. (See Library of the Secretary of State for India.)]

5525. Inspector General of Fortifications (Horse Guards, Whitehall, S. W.). [i]

5527. Institute of Actuaries of Great Britain and Ireland (address to the care of Statistical Society, 9 Adelphi Terrace, Strand, W. C.). [iii]

5529. Institute of Mechanical Engineers [from Birmingham] (10 Victoria Chambers, Victoria Street, S. W.). [i]

5531. Institution of Civil Engineers (25 Great George Street, Westminster, S. W.). [iii]

5533. Institution of Hydronomical and Nautical Engineers (care of Mr. Potter, 31 Poultry, E. C.). [i]

5535. Institution of Naval Architects (5 Adelphi Terrace, Strand, W. C.)

5537. Intelligence Branch, War Office (18 Queen Anne's Gate, S. W.). [i]

5539. Iron and Steel Institute (care of E. & F. N. Spon, Savoy Street, Strand). [i]

5541. "Iron" (161 Fleet Street). [i]

5543. Journal of the Royal Geographical Society (formerly Geographical Magazine).

[Journal of Conchology. (See Leeds).]

[Journal of Philology. (See Cambridge).]

[Journal of the Royal Agricultural Society. (Identical with the Royal Agricultural Society.)

[Journal of the Royal Anthropological Society. (Identical with Royal Anthropological Institute.)]

5545. Journal of Science (3 Boy Court, Ludgate Hill). [i]

[Journal Society of Arts. (The organ of the Society for the Encouragement of Arts, Manufactures, and Commerce.)]

5547. "Knowledge" (care of Wyman & Sons, Green Queen Street, W. C.). [i]

5549. "Land and Water" (Salisbury Court, Fleet street, E. C.). [i]

5551. Library Association of the United Kingdom (13 South Square, Gray's Inn, W. C.). [i]

5553. Library of the Committee of Privy Council for Trade (Whitehall, S. W.). [iii]

5555. Library of Corporation of City of London (Guildhall, E. C.). [iii]

5557. Library of the Foreign Office (Whitehall, S. W.). [i]

5559. Library of the House of Commons (Westminster, S. W.). [iii]

London—Continued.

5561. Library of the House of Lords (Westminster, S. W.). [i]
5563. Library of the Secretary of State for India (India Office). [i]
["Life Boat." (This is the organ of the Royal National Life Boat Institution.)]
5565. Lindley Library, Royal Horticultural Society, South Kensington (care of Dr. M. T. Masters, 41 Wellington Street, Strand, W. C.). [i]
5567. Linnæn Society (Burlington House, W.). [iii]
5569. Live Stock Journal (La Belle Sauvage Yard, Ludgate Hill, E. C.). [i]
5571. Local Government Board (Whitehall, S. W.) [i]
5573. London and Middlesex Archæological Society (4 St. Martin's Place, Trafalgar Square, W. C.). [i]
5575. London, Edinburgh, and Dublin Philosophical Magazine (care of Taylor & Francis, Red Lion Court, Fleet Street, E. C.). [i]
5577. London Hospital. [i]
5579. London Illustrated News (198 Strand, W. C.). [i]
5581. London Institution (Finsbury Circus, E. C.). [iii]
5583. London Library (12 St. James Square, S. W.). [iii]
5585. London Mathematical Society (22 Albemarle Street, W.) [i]
5587. London Mechanics' Institution. [i]
5589. London Society for Promoting Christianity among the Jews (16 Lincoln's Inn Fields, W. C.). [i]
5591. Lords of Her Majesty's Treasury. [i]
5593. Mark Lane Express (Clement's Inn Passage).
5595. Medical Press and Circular.
5597. Medical Society of London (11 Chandos Street, Cavendish Square, W.). [i]
5599. Medical Times (care of J. & A. Churchill, New Burlington, S. W.). [i]
5601. Meteorological Office (116 Victoria Street). [i]
[Meteorological Society. (See Royal Meteorological Society.)]
5603. "Mind" (Williams & Norgate, 14 Henrietta Street, Covent Garden, W. C.). [i]
5605. Mineralogical Magazine (care of R. H. Scott, 116 Victoria Street, S. W.). [i]
5607. Mineralogical Society of Great Britain (care of R. H. Scott, 116 Victoria Street, S. W.). [i]
5609. Mining Journal (26 Fleet street, E. C.). [i]
5611. Mining World (234–236 Gresham House, Old Broad Street, E. C.). [i]
5613. Museum of Guy's Hospital (9 St. Thomas Street, Borough, S. E.). [i]

London—Continued.

5615. Museum of Practical Geology (Jermyn Street, S. W.). [iii]

5617. National Association for the Promotion of Social Science (1 Adams Street, Adelphi, W. C.). [i]

5619. "Nature" (care of Macmillan & Co., Bedford Street, Strand, W. C.). [i]

5621. Nautical Almanac Office (Vendom Buildings, Gray's Inn, W. C.). [i]

5623. Nineteenth Century (care of Kegan, Paul & Co., Paternoster Square, E. C.). [i]

[Numismatic Chronicle. (Organ of Numismatic Society.)]

5625. Numismatic Society (22 Albemarle Street, W.). [i]

5627. "Observatory" (care of Taylor & Francis, Red Lion Court, Fleet Street, E. C.). [i]

5629. Obstetrical Society of London (53 Berners Street, W.). [i]

5631. Odontological Society of Great Britain (Leicester Square, W. C.). [i]

5633. Palæontographical Society (Burlington House, W.). [i]

[Palæontological Society. (Identical with Palæontographical Society.)]

5635. Palestine Exploration Fund (1 Adam Street, Adelphi, W. C.). [i]

5637. Pathological Society (53 Berners Street, W.). [i]

[Pharmaceutical Journal and Transactions. (Organ of the Pharmaceutical Society.)]

5639. Pharmaceutical Society (17 Bloomsbury Square, W. C.). [i]

5641. Philological Society (care of University College, Gower Street, W. C.). [iii]

5643. Photographic Society (5a Pall Mall East, S. W.). [i]

5645. Physical Society of London (Science Schools, South Kensington). [i]

[Popular Science Review. (Discontinued.)]

5647. Post-Office Library and Literary Association (St. Martin's Le Grand, E. C.). [i]

[Public Free Library. (Identical with Free Public Library.)]

[Quarterly Journal of Science. (Same as Journal of Science.)]

[Queensland Government Agency (1 Westminster Chambers, S. W.).] (Same as 5365.)

5649. Quekett Microscopical Club (University College, Gower Street, W. C.). [i]

5651. Ray Society (Burlington House, W.). [i]

[Record Office, India Office. (See Library of the Secretary of State for India.)]

London—Continued.

5653. Reform Club (Pall Mall, S. W.). [i]
5655. "Reliquary" Quarterly Archæological Journal and Review (Bemrose & Sons, Paternoster Square). [i]
5657. Royal Agricultural Society of England (Hanover Square, W.). [iii]
5659. Royal Archæological Institute of Great Britain and Ireland (Oxford Mansions, Oxford Street, W.). [iii]
5661. Royal Asiatic Society of Great Britain and Ireland (Albemarle Street, W.). [iii]
5663. Royal Astronomical Society (Burlington House, Piccadilly, W.). [iii]
5665. Royal Botanic Society (Inner Circle, Regent's Park, N. W.). [i]
5667. Royal College of Physicians of London (Pall Mall East). [i]
5669. Royal College of Surgeons of England (Lincoln's Inn Fields, W. C.). [iii]
5671. Royal Colonial Institute (15 Strand, W. C.). [i]
[Royal Engineers' Headquarters Library. (See Chatham.)]
[Royal Engineers' Institute. (See Chatham.)]
5673. Royal Geographical Society of London (1 Savile Row, W.). [iii]
[Royal Geological Society. (Identical with Geological Society.)]
5675. Royal Historical Society (11 Chandos Street, Cavendish Square). [i]
5677. Royal Horticultural Society of London (South Kensington, S. W.). [iii]
5679. Royal Humane Society (4 Trafalgar Square). [i]
5681. Royal Institute of British Architects (9 Conduit Street, W.). [i]
5683. Royal Institution of Great Britain (Albemarle Street, W.). [iii]
5685. Royal Medical and Chirurgical Society (53 Berners Street, W.). [i]
5687. Royal Meteorological Society [formerly Meteorological Society, and later British Meteorological Society]. [i]
5689. Royal Microscopical Society (King's College, Strand, W. C.). [iii]
[Royal Military College. (See Farnboro'.)]
5691. Royal National Life-Boat Institution (14 John Street, Adelphi). [i]
[Royal School of Mines. (Same as Museum of Practical Geology.)]
5693. Royal Society of Literature (22 Delahay Street, Westminster). [i]

London—Continued.

5695. Royal Society of London (Burlington House, W.). [ii]
5697. Royal United Service Institution (Whitehall, S.W.). [i]
5699. Saint Bartholomew's Hospital (Smithfield, E. C.). [i]
5701. Saint George's Hospital (Hyde Park, W.). [i]
5703. Saint Thomas's Hospital (Albert Embankment, S. E.). [i]
5705. Salmon Fishery Office (Whitehall, S. W.). [i]
5707. Science and Art Department (South Kensington). [iii]
[Scientific Club. (Dissolved.)]
[Science Gossip. (See Hardwicke's Science Gossip.)]
[Scientific Opinion. (Same as English Mechanic and World of Science.]
[Scientific Roll. (Irregular.])
5709. Selenographical Society (care of Royal Astronomical Society, Burlington House, W.). [i]
5711. Symons' Monthly Meteorological Magazine (62 Camden Square, N. W.).
[Silk Supply Association. (Discontinued.)]
[Social Science Association. (Same as National Association for the Promotion of Social Science.)]
5713. Society of Antiquaries of London (Burlington House, W.) [iii]
5715. Society of Apothecaries of London (Water Lane, Blackfriars, E. C.). [i]
5717. Society of Biblical Archæology (11 Hart Street, Bloomsbury). [i]
5719. Society of Cymmarodrin (Lonsdale Chambers, Chancery Lane).
5721. Society for the Encouragement of Arts, Manufactures, and Commerce (John Street, Adelphi, W. C.). [iii]
5723. Society for the Promotion of Christian Knowledge (Northumberland Avenue, S. W.). [i]
5725. Society for the Promotion of Hellenic Studies (care of Macmillan & Co., Bedford Street, Strand). [i]
5727. Society for the Propagation of the Gospel in Foreign Parts (19 Delahay Street, Westminster, S. W.). [i]
5729. Society of Engineers (6 Westminster Chambers, Victoria Street, S. W). [i]
5731. Society of Public Analysts (37 Lombard Street, E. C.). [i]
5733. Society of Telegraph Engineers (4 Broad Sanctuary, Westminster, S. W.). [i]
5735. South Kensington Educational Library.
5737. South Kensington Museum. [i]
[Statistical Society, King's College. (Identical with Statistical Society of London.)]

London—Continued.

5739. Statistical Society of London (9 Adelphi Terrace, Strand, W. C.). [iii]
5741. Surrey Archælogical Society (8 Dane's Inn, Strand, W. C.). [i]
5743. Syrio-Egyptian Society (9 Conduit Street, W.). [i]
5745. "The Aquarium" (1 Westminster, S. W.). [i]
5747. "The Economist" (349 Strand, W. C.). [i]
5749. "The Colliery Guardian and Journal of the Coal and Iron Trades." [i]
5751. "The Electrical Review and Telegraphic Journal" [formerly the Telegraphic Journal] (22 Paternoster Row, E. C.). [i]
5753. "The Electrician."
5755. "The Engineer" (163 Strand, W. C.). [i]
5757. "The Engineering" (35 and 36 Bedford Street, Strand). [i]
5759. "The Field" (346 Strand, W. C.). [i]
5761. "The Garden" (37 Southampton Street, Covent Garden, W. C.). [i]
5763. "The Ibis" (1 Paternoster Row, E. C.).
5765. "The Lancet."
["The Oriental" (Ceased to appear.)]
5767. "The Statesman's Yearbook." [i]
5769. "The Spectator" (Wellington Street, Strand, W. C.). [i]
["The Telegraphic Journal." (See "The Electrical Review and Telegraphic Journal.")]
5771. "The Times" (Printing House Square, Blackfriars, E. C.). [i]
5773. Trawling Commission.
5775. Trübner & Co. (57 and 59 Ludgate Hill, E. C.). [i]
5777. University College (Gower Street, W. C.). [i]
5779. U. S. Dispatch Agency (4 Trafalgar Square, W. C.).
5781. Victoria Institute [or Philosophical Society of Great Britain] (8 Adelphi Terrace, W. C.). [i]
5783. Willughby Society for the Reprinting of Scarce Ornithological Works (6 Tenterden Street, Hanover Square, W.). [i]
5785. Worshipful Company of Clockmakers (Town Clerk's Office, Guildhall, E. C.). [i]
[Zoological Department of the British Museum. (See British Museum.)]
5787. Zoological Record Association (care of Van Voorst, 1 Paternoster Row, E. C.). [i]
5789. Zoological Society of London (1 Hanover Square, W.). [iii]
5791. "Zoologist" (care of Van Voorst, 1 Paternoster Row, E. C.). [i]

Lowestoft.

5793. Norfolk and Suffolk Fish Acclimatization Society. [i]

Macclesfield.

5795. Macclesfield Society for Acquiring Useful Knowledge. [i]

Maidstone.

5797. Kent Archæological Society. [i]

Manchester.

5799. Chetham's Library. [i]
5801. Geological Society (36 George Street). [i]
5803. Lancashire Independent College. [i]
5805. Literary and Philosophical Society of Manchester (36 George Street). [iii]
5807. Manchester Field Naturalists' and Archæologists' Society. [i]
5809. Manchester Literary Club. [i]
5811. Manchester Public Free Library [formerly "and Museum"]. [iii]
5813. Manchester Scientific Students' Association (97 Bridge Street). [i]
5815. Numismatic Society. [i]
5817. Owen's College. [iii]
["Universal Engineer." (Discontinued.)]
5819. Vegetarian Society (56 Peter Street).

Marlborough.

5821. Marlborough College Natural History Society. [i]

Newbury.

5823. Newbury District Field Club. [i]

Newcastle (*Staffordshire*).

5825. North Staffordshire Naturalists' Field Club. [i]

Newcastle-upon-Tyne.

5827. Antiquarian Society. [i]
5829. Durham College of Science [formerly College of Physical Science]. [i]
5831. Central Exchange, News Room, Art Gallery, and Industrial Exhibition. [i]
5833. Literary and Philosophical Society. [i]
5835. Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne (Museum, Newcastle). [iii]
5837. North of England Institute of Mining and Mechanical Engineers. [i]
[North Staffordshire Naturalists' Field Club. (See Newcastle, Staffordshire.)]
[Public Libraries. (See Central Exchange, &c.)]
[Reading-Room. (See Central Exchange, &c.)]
5839. Tyneside Naturalists' Field Club (Museum, Newcastle). [i]

Norwich.

5841. Norfolk and Norwich Archæological Society. [i]
5843. Norfolk and Norwich Museum. [i]
5845. Norfolk and Norwich Naturalists' Society. [i]
5847. Norwich Geological Society. [i]

Nottingham.

5849. Free Library and Museum of the Borough of Nottingham. [i]
5851. Nottingham Literary and Philosophical Society.
5853. Nottingham Mechanics' Association (Mechanics' Hall Library). [i]
5855. Nottingham School of Art. [i]
5857. United Lunatic Asylum. [i]

Oldham.

5859. Oldham Free Reference Library, Museum, and Art Gallery.

Oscolt.

5861. Oscolt College, Erdington, Birmingham.
5863. St. Mary's College.

Oxford.

5865. Ashmolean Society. [i]
5867. Bodleian Library. [iii]
5869. Library of the Sumerville Hall for Ladies.
5871. Magdalen College. [i]
5873. Museum of Natural History. [i]
5875. Oxford Architectural and Historical Society (17 New Inn Hall Street).
5877. Oxford, &c., Messenger of Mathematics.
5879. Oxford Free Library. [i]
[Oxford University Library. (Same as Bodleian Library.)]
5881. Oxford University Entomological Society. [i]
5883. Oxford University Indian Institute.
5885. Oxford University Observatory. [i]
5887. Radcliffe Library (Museum). [i]
5889. Radcliffe Observatory. [iii]
[Savilian Observatory.]

Penzance.

5893. Natural History and Antiquarian Society. [i]
5895. Penzance Public Library. [i]
5897. Royal Geological Society of Cornwall. [i]

Plymouth.

[Devonshire Association for the Advancement of Science, Literature, and Arts. (See Exeter.)]

Plymouth—Continued.
5899. Plymouth Institution and Devon and Cornwall Natural History Society. [i]
5901. Plymouth Free Library [formerly Museum]. [i]

Portsmouth.
5903. Royal Naval College. [i]

Reading.
5905. Public Library and Museum.

Redruth.
5907. The Mining Association and Institute of Cornwall. [i]

Richmond (*Surrey*).
5909. Free Public Library.

Richmond (*Yorkshire*).
5911. Richmond and North Riding Naturalists' Field Club. [i]

Rugby.
5913. Natural History Society of Rugby School. [i]
5915. Temple Observatory. [i]

Ryde (*Isle of Wight*).
5917. Philosophical and Scientific Society. [i]

St. Albans.
5919. St. Albans' Architectural and Archæological Society. [i]

Salford.
5921. Salford Royal Museum and Library. [i]
5923. Town Council of Salford. [i]
5925. Working Men's College. [i]

Salisbury.
5927. Blackmore Museum.

Sandhurst.
[Royal Military College. (See Farnsboro'.)]
[Royal Staff College. (See Farnsboro'.)]

Sheffield.
5929. Firth College. [i]
5931. Literary and Philosophical Society. [i]

Southampton.
5933. Hartley Institution. [iii]
5935. Ordnance Trigonometrical Survey of Great Britain and Ireland (1 St. Martin's Place, London, W. C.). [i]
5937. South of England Literary and Philosophical Society. [i]

Southport.

5939. Aquarium. [i]
5941. Free Public Library. [i]

South Shields.

5943. Public Free Library. [i]

Shrewsbury.

5945. Shropshire Archæological and Natural History Society. [i]

Staines.

5947. Royal India Engineering College. [i]

Stoke-on-Trent.

5949. Free Library and Museum [formerly Athenæum].
5951. North Staffordshire Institute of Mining and Mechanical Engineers. [i]

Taunton.

5953. Somersetshire Archæological and Natural History Society. [i]

Teignmouth.

[Teign Naturalists' Field Club. (*See* Exeter.)]

Torquay.

5955. Natural History Society. [i]

Truro.

[Miners' Association, &c. (See Camborne.)]
[Mineralogical Magazine. (See London.)]
[Mineralogical Society. (See London.)]
5957. Royal Institution of Cornwall. [i]

Twickenham.

5959. Twickenham Economic Museum. [i]

Warrington.

5961. Warrington Museum. [i]

Warwick.

5963. Warwickshire Natural History and Archæological Society. [i]

Watford.

5965. Hertfordshire Natural History Society and Field Club (care of Mr. Hopkinson, 95 New Bond Street, London, W.) [i]

Wellington.

[Wellington College. (See Wokingham.)]

Whalley (*Lancashire*).

5967. Stonyhurst College. [i]
5969. Stonyhurst College Observatory. [i]

Whitby.
5971. Literary and Philosophical Society Museum. [i]

Wigan.
5973. Mining School.

Winchester.
[Winchester and Hampshire Scientific and Literary Society. (Dissolved.)]

Windsor.
[Eton College. (See Eton.)]
5975. Royal Library. [i]

Wokingham.
5977. Wellington College Natural History Society [formerly in Wellington (address parcels " Wellington College, Berkshire, South Eastern Railway). [i]

Wolverhampton.
5979. Association of Chemists and Druggists.

Woolwich.
5981. Royal Artillery Institution. [iii]
5983. Royal Military Academy. [iii]

Wycombe (*Buckinghamshire*).
5985. High Wycombe Natural History Society. [i]

York.
[Yorkshire Agricultural Society.]
5987. Yorkshire Philosophical Society. [i]

IRELAND.

Armagh.
5989. Observatory. [iii]
5991. Public Library. [iii]

Belfast.
5993. Belfast Institution. [i]
5995. Belfast Naturalists' Field Club. [i]
5997. Chemico-Agricultural Society of Ulster. [i]
5999. Flax Supply Extension Association. [i]
6001. Natural History and Philosophical Society. [iii]
6003. Northeast Agricultural Association. [i]
6005. Queen's College. [iii]

Collooney.
6007. Markree Observatory. [i]

Cork.
6009. Chamber of Commerce.
6011. Christian Schools.

Cork—Continued.

6013. Cuvierian and Archæological Society. [i]
6015. Library of Queen's College. [iii]
6017. Royal Cork Institution. [i]

Dublin.

6019. Catholic College of Ireland. [iii]
6021. Chemical Society of Dublin. [i]
["Copernicus" International Journal of Astronomy. (Discontinued.)]
[Deaf and Dumb Institution of Cabra. (Identical with St. Joseph's Cabra Institution, the former the female, the latter the male, institution.)]
[Dublin Geological Society. (See Royal Geological Society of Ireland, No. 6065.)]
6023. Dublin Library (D'Oliver street).
[Dublin Quarterly Journal of Science. (Discontinued)]
6025. Dublin Society of Natural History. [i]
6027. Dublin University. [i]
6029. Dublin University Biological Association.
6031. Dublin University Philosophical Association.
[Dublin University Zoölogical Botanical Association. (Dissolved.)]
6033. Freeman's Journal.
6035. Geological Survey of Ireland. [i]
6037. Institution of Civil Engineers of Ireland (35 Dawson street). [i]
6039. Institution for Deaf and Dumb, Claremont Glasnevin. [i]
6041. Irish Archæological and Celtic Association.
6043. Irish Fisheries Commission.
6045. Irish Medical Association. [i]
6047. Journal of Medical Science.
6049. Library of Trinity College. [iii]
6051. National Library of Ireland, Science and Art Department (Leinster House, Kildare Street). [i]
6053. Observatory of Trinity College. [i]
6055. Pharmaceutical Society. [i]
6057. Royal Agricultural Society. [i]
6059. Royal College of Surgeons in Ireland.
6061. Royal Dublin Society (Kildare Street). [iii]
6063. Royal Geographical Society.
6065. Royal Geological Society of Ireland. [i]
6067. Royal Irish Academy. [iii]
6069. Royal Zoölogical Society of Ireland. [Has no library.]
6071. St. Joseph's Cabra Institution for the Deaf and Dumb. [See also Deaf and Dumb Institution of Cabra.] [i]

Dunsinsk.

6073. Observatory. [i]
6075. "Urania," International Journal of Astronomy. [i]

Ennis.

6077. Public Library.

Galway.

6079. Library of Queen's College. [iii]

Kilkenny.

6081. Royal Historical and Archæological Association of Ireland (packages to be addressed to Rev. J. Graves, care of McGlashan & Gill, 50 Upper Sackville Street, Dublin, per Hayden & Co., Warwick Square, London, E. C.). [i]

Londonderry.

6083. Magee College. [iii]

Maynooth.

6085. St. Patrick's College. [iii]

Parsonstown.

6087. Lord Rosse's Observatory.

Valencia.

6089. Observatory of the London Meteorological Office (address 116 Victoria Street, London). [i]

SCOTLAND.

Aberdeen.

6091. Dun Echt Observatory. [i]
6093. Natural History Society. [i]
6095. Philosophical Society. [i]
6097. University. [iii]

Note.—All packages for Aberdeen can be sent care of Wyllie & Sons, Union Street, Aberdeen, per Hamilton & Co., Paternoster Row, London, E. C.

Alloa.

6099. Society of Natural Science and Archæology. [i]

Dumfries.

6101. Dumfriesshire and Galloway Natural History and Antiquarian Society. [i]

Dundee.

6103. Association of Watchmakers and Jewellers. [i]
6105. Free Library and Museum. [i]
6106. University College. [ii]

Edinburgh.

6107. Arizona Copper Company (12 Frederick Street.)
6109. Ben Nevis Observatory.

Edinburgh—Continued.

6111. Board of Northern Lighthouses. [i]
6113. Botanical Society. [Has no library; gives books to Royal Botanic Garden of Edinburgh.]
6115. Caledonian Horticultural Society. [i]
6117. Clarendon Historical Society.
6119. Edinburgh Geological Society. [i]
6121. Edinburgh Medical and Surgical Journal.
6123. Edinburgh Museum.
6125. Edinburgh Watt Institution and School of Arts. [i]
6127. Faculty of Advocates. [iii]
6129. Fishery Board for Scotland.
6131. General Board of Lunacy. [i]
6133. Geological Survey of Scotland. [i]
6135. Highland and Agricultural Society of Scotland. [i]
6137. Horological Society of Edinburgh.
6139. Medico-Chirurgical Society of Edinburgh. [i]
6141. Meteorological Society of Scotland. [i]
6143. Museum of Science and Arts. [iii]
6145. Pharmaceutical Society (North British Branch). [i]
6147. Royal Botanic Garden of Edinburgh. [i]
6149. Royal College of Physicians. [i]
6151. Royal Institution for the Encouragement of Fine Arts in Scotland. [i]
6153. Royal Observatory. [iii]
6155. Royal Physical Society. [i]
6157. Royal Scottish Society of Arts. [i]
6159. Royal Society of Edinburgh. [iii]
6161. Scottish Arboricultural Society. [i]
6163. Scottish Fisheries Improvement Association.
6165. Scottish Geographical Society.
6167. Society of Antiquaries in Scotland.
6169. Society of Writers to H. M. Signet. [i]
6171. University Library. [iii]
6173. University Fleming.
6175. "The Scottish Naturalist."
6177. "The Scotchman."

[NOTE.—All packages for Edinburgh to care of Williams & Norgate, 14 Henrietta Street, Covent Garden, London, W. C.]

Glasgow.

6179. Anderson's College (204 George Street). [i]
6181. Archæological Society (88 West Regent Street). [i]
6183. Faculty of Physicians and Surgeons of Glasgow [formerly Glasgow and West of Scotland Medical Association] (care of James Hadden, 65 Sanchihall Street, Glasgow, per Hayden & Co., Warwick Square, London, E. C.). [i]

Glasgow—Continued.

6185. Geological Society (76 Henderson Street). [i]
6187. Glasgow University (care of Mr. Maclehose, Glasgow, per Mr. Billing, Ave Maria Lane, London, E. C.). [iii]
6189. Glasgow Medical Journal (care of James Hadden, 65 Sanchihall Street, Glasgow, per Hayden & Co., Warwick Square, London, E. C.). [i]
6191. Institution of Engineers and Shipbuilders in Scotland. [i]
6193. Mitchell Library (Ingram Street, East). [i]
6195. Natural History Society of Glasgow (207 Bath Street). [i]
6197. Observatory. [i]
6199. Philosophical Society (207 Bath Street). [iii]
[Public Library of the City of Glasgow. (Identical with Mitchell Library.)]

Hamilton.

6201. The Mining Institution of Scotland.

Kilmarnock.

6203. Observatory. [i]

Montrose.

6205. Montrose Natural History and Antiquarian Society. [i]

Peebles.

6207. The Chambers Institution (care of Messrs. W. & R. Chambers, Paternoster Row, London, E. C.). [i]

Perth.

6209. Murray Royal Institution. [i]
6211. Perthshire Society of Natural Science. [i]
6213. "Scottish Naturalist."

St. Andrews.

6215. University Library. [iii]

WALES.

Swansea.

6217. [Central] Public Library.
6219. Royal Institution of South Wales. [i]
6221. South Wales Institute of Engineers. [i]

Tenby.

[Cambrian Archæological Association. (Dissolved.)]

Welshpool.

6223. Powy's Land Club. [i]
6225. Powy's Land Museum and Library. [i]

GREECE.

Athens.

6227. Cercle Littéraire "Byron" (*"Byron" Literary Circle*). [i]
6229. Government of Greece. [i]
6231. Library of His Majesty the King. [iii]

Athens—Continued.

6233. Ministère de l'Intérieur.

6235. Musée Botanique de l'Université Nationale (*Botanical Museum of the National University*). [i]

[National Library. See United National and University Library.]

6237. National Numismatic Museum.

[National University. See United National and University Library.]

6239. Natural History Museum of the National Library. [i]

6241. Observatory. [i]

6243. Société Archéologique d'Athènes (*Archæological Society of Athens*). [i]

6245. Société Littéraire "Le Parnasse" (*Parnassus Literary Society*). [i]

6247. Société Médicale (*Medical Society*). [i]

6249. United National and University Library. [iii]

ICELAND.

Akureyri.

6253. The Northern Provincial Library. [i]

Mödruvellir.

6255. Technical School. [i]

Reykjavik.

6257. Divinity School. [i]

6259. Fornleifarfjèlag (*Icelandic Archæological Society*). [i]

6261. Hid Islenzka Bókmentafjèlag (*Literary Society of Iceland*). [i]

6263. Hinn løeđi skóli í Reykjavík (*College of Reykjavik*).

6265. Island's Stiptisbókasafn (*Library of the Icelandic Diocese*). [iii]

6267. Medical School. [i]

6269. National Library of Iceland. [i]

6271. Natural History Museum of the College.

6273. Pjódvinafjèlag (*Society of Friends of the People*).

6275. Students' Library. [i]

6277. Scientific Association of Iceland. [i]

Stykkisholmur.

6279. The Western Provincial Library. [i]

ITALY.

Arezzo.

6281. Accademia Petrarca (*Petrarca Academy*), [formerly Accademia Valdarnese del Poggio]. [i]

Bergamo.

6283. Accademia Carrara di Belle Arti (*Carrara Academy of Fine Arts*). [i]

Bergamo—Continued.

6285. Ateneo di Scienze, Lettere ed Arti di Bergamo (*Bergamo Atheneum of Science, Letters, and Arts*). [i]
6287. Municipio di Bergamo (*City Government*). [i]
6289. Società Industriale Bergamasca (*Bergamo Industrial Society*). [i]

Bologna.

6291. Accademia delle Scienze dell' Istituto di Bologna (*Academy of Sciences of the Institute of Bologna*). [iii]
6293. Archivos per la Zoologia, l' Anatomia, e la Fisiologia (*Archives of Zoology, Anatomy, and Physiology*). [i]
6295. Gabinetto di Anatomia dell' Università (*Anatomical Cabinet of the University*). [i]
6297. Museo Civico (*Public Museum*).
6299. Museo di Geologia dell' Università (*Geological Museum of the University*). [Wants all packages addressed to G. Capellini.] [i]
6301. Osservatorio Astronomico (*Astronomical Observatory*). [i]
6302. Reale Deputazione di Storia Patria per le Romagna (*Royal Commission for the National History of the Romagna*). [i]
6303. Repertorio Italiano per la Storia Naturale (*Index of Natural History*).
6305. Repertorium Italianum di Bianconi (*Italian Index of Biancon*).
6307. Scuola Anatomica di Bologna (*Anatomical School of Bologna*). [i]
6309. Società Agraria della Provincia di Bologna (*Agrarian Society of the Province of Bologna*). [i]
6311. Società Medico-Chirurgica (*Medico-Chirurgical Society*). [i]
6313. Università di Bologna (*University of Bologna*). [i]

Brescia.

6315. Ateneo di Brescia (*Atheneum of Brescia*). [iii]
6316. Reale Istituto Tecnico (*Royal Technical Institute*). [i]

Cagniola.

[Fondazione Scientifica. (See Milan.)]

Carrara.

6317. Accademia Reale di Belle Arti (*Royal Academy of Fine Arts*).

Catania.

6319. Accademia Gioenia di Scienze Naturali (*Gioenia Academy of Natural Sciences*). [iii]

Cesena.

6321. Comizio Agrario del Circondario (*Agricultural Committee*). [i]

Firenze (*Florence*).

6323. Archivio per l' Antropologia e la Etnologia (*Archives of Anthropology and Ethnology*).
6325. Biblioteca Marucelliana (*Marucelliana Library*). [i]
6327. Biblioteca Nazionale (*National Library*). [iii]
6329. Biblioteca Ricardiana (*Ricardiana Library*). [i]
6331. Biblioteca di Sua Maestà il Re d' Italia (*Library of His Majesty the King of Italy*). [i]
6333. Il Circolo Filologico de Firenze (*Philological Circle of Florence*).
6335. Istituto di Studi Superiori in Firenze (*Florence Institute of Higher Studies*). [i]
6337. Istituto Geografico Militare (*Military Geographical Institute*).
6339. Istituto Topografico Militare (*Military Topographical Institute*). [i]
6341. Museo Nazionale d' Antropologia e di Etnologia (*National Museum of Anthropology and Ethnology*). [i]
6343. Nuovo Giornale Botanico Italiano (*New Italian Botanical Journal*). [i]
6345. "Opinione" (*Opinion*).
6347. Osservatorio Astronomico di Arcetri (*Astronomical Observatory*). [i]
6349. Osservatorio del Reale Museo (*Observatory of the Royal Museum*). [i]
6351. Reale Accademia Della Crusca (*Royal Academy of Della Crusca*). [i]
6353. Reale Accademia Economico-Agraria dei Georgofili (*Royal Economico-Agrarian Academy of Agriculturists*). [i]
6355. Reale Deputazione degli Studi di Storia Patria per le provincie della Toscana, Umbria, e della Marche (*Royal Commission for the Study of the History of the Provinces of Tuscany, Umbria, and Marche*). [i]
6357. Reale Museo di Fisico e Storia Naturale (*Royal Museum of Physics and Natural History*). [iii]
6359. Reale Società Toscana di Orticoltura (*Royal Tuscan Society of Horticulture*).
6361. Royal Italian Geological Commission.
6363. Società Entomologica Italiana (*Italian Entomological Society*). [i]
6365. Società Italiana di Antropologia, Etnologia, e Psicologia comparata (*Italian Society of Anthropology, Ethnology, and Comparative Psychology*). [i]

Forlì.

6367. Direzione dell' "Industriale Italiano" [Febo Gherardi] (*The Office of Italian Industry*). [i]
6369. Giornale Agrario Italiano (*Italian Agrarian Journal*).

Genova (*Genoa*).

6371. Accademia delle Scienze, Lettere ed Arti (*Academy of Sciences, Letters, and Arts*). [iii]
6373. Accademia Medico-Chirurgica (*Medico-Chirurgical Academy*). [i]
6375. Museo Civico di Storia Naturale (*Civic Museum of Natural History*). [i]
6377. Osservatorio della Reale Università (*Observatory of the Royal University*). [i]
6379. Reale Accademia delle Scienze Medicale Genova (*Royal Academy of Medical Sciences, of Genoa*). [i]
6381. Reale Istituto di Sordo-Muti (*Royal Institute for the Deaf and Dumb*). [i]
6383. Reale Istituto Tecnico e di Marina (*Royal Technical and Naval Institute*). [i]
6385. Reale Scuola Superiore Navale (*Royal Naval College*). [i]

[Reale Scuola di Marina (*Royal Naval School*). See Regia Accademia Navale di Livorno.]

6387. Reale Università (*Royal University*). [iii]
6389. Società di Lettura e Conversazione Scientifiche (*Society of Lectures and Scientific Conversations*). [i]
6391. Società Ligure di Storia Patria (*Ligurian Society of National History*). [i]
6393. Ufficio Idrografico della Regia Marina (*Hydrographic Office of the Royal Navy*). [i]

Jesi.

6395. Comizio Agrario (*Agricultural Committee*). [i]

Livorno (*Leghorn*).

6396. Regia Accademia Navále (*Royal Naval Academy*). [Succeeds the Naval Schools of Genoa and Naples.] [i]

Lucca.

6397. Reale Accademia Lucchese di Scienze, Lettere ed Arti (*Royal Lucca Academy of Science, Letters, and Arts*). [iii]

Mantova (*Mantua*).

6399. Reale Accademia Virgiliana (*Royal Virgilian Academy*). [i]

Messina.

6401. "La Scienza Contemporanea" (*Co-temporary Science*). [i]
6403. Reale Accademia Carolina (*Royal Carolina Academy*). [i]

Milano.

6405. Accademia Fisico-Medico-Statistica di Milano (*Physico-Medico-Statistical Academy of Milan*). [i]
6407. Accademia Scientifico-Litteraria (*Scientific Literary Academy*). [i]
6409. Accademia Storico-Archeologica (*Archæological Academy*).

Milano—Continued.

6411. Annali Universali de Medicina e Chirurgia (*Universal Annals of Medicine and Surgery*).

6413. Biblioteca Ambrosiana (*Ambrose Library*). [i]

6415. Biblioteca Nazionale di Brera (*National Library of Brera*). [iii]

["Bolletino Scientifico" (*Scientific Bulletin*).]

[Collegio degli Avvocati. (See Consiglio dell' Ordine degli Avvocati.]

6417. Collegio degli Ingegneri ed Architetti (*College of Engineering and Architecture*). [i]

6419. Consiglio dell' Ordine degli Avvocati in Milano [via Silvio Pellico No. 8] (*Law College*).

6421. Direzione dell' "Bollettino Scientifico" [Corso Venezia 5]. (*Scientific Bulletin*). [i]

6423. Direzione dell' "Italia Agricole" (*The Italian Farmer*). [i]

6425. Fondazione Scientifica Cagnola (*Scientific Institution*). [Branch of the R. Istituto Lombardo.]

6427. Ulrico Hoepli, bookseller. [i]

6429. Municipio di Milano (*City Government of Milan*). [i]

6431. Museo Civico di Storia Naturale (*Civic Museum of Natural History*). [i]

6433. Museo di Storia Naturale dei Fratelli Villa (*Natural History Museum of the Fratelli Villa*). [i]

6435. Museo Patrio di Archeologia (*Museum of National Archæology*).

6437. Ospitale Maggiore di Milano (*Grand Hospital of Milan*). [i]

6439. R. Accademia di Belle Arti (*Royal Academy of Fine Arts*). [i]

6441. R. Istituto Lombardo di Scienze e Lettere (*Royal Institute of Sciences and Letters of Lombardy*). [iii]

6443. R. Istituto dei Sordo-Muti (*Royal Institute for the Deaf and Dumb*). [i]

6445. R. Istituto Tecnico-Superiore (*Royal Technical College*). [i]

6447. R. Osservatorio Astronomico di Brera (*Royal Astronomical Observatory of Brera*). [i]

6449. R. Scuola Superiore di Agricoltura (*Royal Agricultural College*). [i]

6451. R. Scuola Superiore di Medicina Veterinaria (*Royal College of Veterinary Medicine*). [i]

6453. Società Agraria di Lombardia (*Agrarian Society of Lombardy*). [i]

6455. Società Crittogamologica Italiana (*Italian Cryptogamical Society*).

6457. Società Generale degli Agricolturi Italiani (*Italian Society of Agriculture*).

Milano—Continued.

6459. Società Geologica (*Geological Society*).
6461. Società d'Incoraggiamento di Arti e Mestieri (*Society for the Encouragement of Arts and the Trades*). [i]
6463. Società Italiana d' Igiena [via Santi Andrea 18] (*Italian Society of Hygiene*). [i]
6465. Società Italiana di Scienze Naturali (*Italian Society of Natural Sciences*). [i]
6467. Società Patriotica (*Patriotic Society*).. [i]
6469. Società Storica Lombardia (*Lombardian Historical Society*). [i]

Modena.

6470. Comizio Agrario (*Agricultural Commission*). [i]
6471. Osservatorio (*Observatory*). [i]
6473. R. Accademia di Scienze, Lettere ed Arti (*Royal Academy of Sciences, Letters, and Arts*). [i]
6475. R. Stazione Agraria Sperimentale (*Royal Agricultural Experimental Station*). [i]
6477. R. Università (*Royal University*). [i]
6479. Società Medico-Chirurgica (*Medico-Chirurgical Society*). [i]
6481. Società Meteorologica Italiana (*Italian Meteorological Society*). [i]
6483. Società di Naturalisti in Modena (*Society of Naturalists in Modena*). [i]

Modica.

6485. Osservatorio Meteorologico (*Meteorological Observatory*). [i]
6487. R. Istituto Tecnico di Modica (*Royal Technical Institute of Modica*). [i]

Moncalieri.

6489. R. Osservatorio del R. Collegio C. Alberto (*Observatory of the Royal College C. Alberto*). [i]

Montevarchi.

6491. R. Accademia Valdarnese del Poggio (*Valdarnese Academy of Poggio*). [i]

Napoli (*Naples*).

6493. Accademia degli Aspiranti Naturalisti (*Academy of Amateur Naturalists*). [i]
6495. Accademia Pontaniana (*Pontaniana Academy*). [i]
6497. Accademia delle Scienze (*Academy of Sciences*).
6499. Associazione Italiana della Croce Rossa (*Italian Society of the Red Cross*).
6501. Biblioteca Nazionale (*National Library*). [iii]
6503. Biblioteca Provinziale (*Provincial Library*). [iii]
6505. Club Africana [via Nuova Monteo Civeto 25] (*African Club*).
6507. Direzione degli "Annali Clinici" [via Incurabili, o nell' Ospedale] (*Clinical Annals*). [i]

Napoli (*Naples*)—Continued.

6509. Direzione "L' Esplorazione"—Rassegna Geografica (*The Exploration, Geographical Review*) [via Roma, gli Toledo, 416].
6511. Istituto di Belle Arti di Napoli (*Neapolitan Institute of Fine Arts*). [i]
6513. "Il Morgagni".
6515. Museo Nazionale di Napoli (*National Museum of Naples*). [i]
6517. R. Accademia di Archeologia, Lettere e Belle Arti (*Royal Academy of Archæology, Letters, and Fine Arts*). [i]
6519. R. Accademia Ercolanese di Archeologia (*Royal Herculanean Academy of Archæology*). [iii]
6521. R. Accademia Medico-Chirurgica (*Royal Medico-Chirurgical Academy*). [i]
6523. R. Accademia delle Scienze e Belle Lettere (*Royal Academy of Sciences and Belles Lettres*). [iii]
6525. R. Accademia di Scienze Fisiche e Matematici (*Royal Academy of Physical and Mathematical Sciences*). [i]
6527. R. Istituto d' Incoraggiamento delle Scienze Naturali, Economiche e Tecnologiche (*Royal Institute for the Promotion of Natural, Economical, and Technical Sciences*). [i]
6529. R. Orto Botanico (*Royal Botanical Garden*). [i]
6531. R. Osservatorio Capo di Monte (*Royal Observatory*). [i]
6533. R. Osservatorio Meteorologico Vesuviano (*Royal Vesuvian Meteorological Observatory*). [i]
6535. R. Scuola Superiore di Medicina Veterinaria (*Royal Veterinary College*). [i]
6537. R. Università (*Royal University*). [i]
6539. Società Reale di Napoli (*Royal Society of Naples*). [i]
6541. Stazione Zoologica di Napoli (*Zoological Station*). [i]

Novara.

6543. Biblioteca Civica (*City Library*). [i]

Padova (*Padua*).

6545. "Gazzetta Medica Italiana" (*Italian Medical Gazette*). [i]
6547. Osservatorio Astronomico dell' Università (*Astronomical Observatory of the University*). [i]
6549. R. Accademia di Scienze, Lettere, ed Arti di Padova (*Royal Academy of Sciences, Letters, and Arts, of Padua*). [iii]
6551. R. Università di Padova (*Royal University of Padua*). [i]
6553. Società d' Incoraggiamento per l'agricoltura e l'industria nella provinica di Padova, e Gabinetto di lettura (*Society for the Encouragement of Agriculture and Industry in Padua*). [i]
6555. Società Veneto-Trentina di Scienze Naturali (*Veneto-Trentina Society of Natural Sciences*). [i]

Palermo.

6557. Accademia Palermitana di Scienze e Lettere (*Palermian Academy of Sciences and Letters*). [iii]
6559. Biblioteca Nazionale (*National Library*). [i]
6561. "Gazzetta Chimica Italiana" (*Italian Chemical Gazette*).
6563. "Il Naturaliste Siciliano" (*The Sicilian Naturalist*).
6565. Orto Botanico (*Botanical Garden*). [i]
6567. R. Istituto Tecnico (*Royal Technical Institute*). [i]
6569. R. Osservatorio (*Royal Observatory*).
6571. Società d' Acclimazione e di Agricoltura in Sicilia (*Society of Acclimation and Agriculture in Sicily*). [i]
6573. Società di Scienze Naturali ed Economiche (*Society of Natural and Economical Sciences*). [i]
6575. Stazione Chimico-Agraria Sperimentale di Palermo (*Chemico-Agricultural Experimental Station of Palermo*). [i]

Paroma.

6577. Bolletino di Paleontologia Italiana (*Italian Paleontological Bulletin*).
6579. R. Biblioteca (*Royal Library*). [i]
6581. R. Orto Botanico (*Royal Botanical Garden*). [i]
6583. R. Osservatorio Astronomico (*Royal Astronomical Observatory*). [i]
6585. Università di Parma (*University of Parma*). [i]
6587. Museo di Storia Naturale (*Natural History Museum*).

Pavia.

6589. Accademia Malaspina (*Malaspina Academy*). [i]
6591. Central Physical Observatory.
6593. R. Università (*Royal University*). [i]

Pesaro.

6595. Accademia Agraria di Pesaro (*Agrarian Academy of Pesaro*). [i]
6597. Osservatorio Meteorologico e Magnetico Valerio (*Valerio Meteorological and Magnetical Observatory*). [i]

Pisa.

6599. Direzione del Nuovo Giornale Botanico Italiano (*The New Italian Botanical Journal*). [i]
6601. "Il Nuovo Cimento."
6603. R. Scuola Normale Superiore (*Royal Normal High School*). [i]
6605. Società Malacologica Italiana (*Italian Malacological Society*). [i]
6607. Società Toscana di Scienze Naturali (*Tuscan Society of Natural Sciences*). [i]
6609. Università (University). [iii]

Pistoja.

6611. R. Accademia di Scienze, Lettere ed Arti (*Royal Academy of Sciences, Letters, and Arts*). [i]

Portici.

6613. R. Scuola Superiore d' Agricoltura (*Royal Agricultural College*).

Ravenna.

6615. Accademia di Belle Arti (*Academy of Fine Arts*). [i]
6617. Società Ravennata (*Ravenna Society*). [i]

Roma.

6621. Accademia dell' Arcadia d' Archeologia et dei Nuovi Lincei (*Arcadian Academy of Archæology*). [i]
6623. Accademia Pontificia dei Nuovi Lincei (*Pontifician Academy*). [iii]
6625. Accademia Romana di Archeologia (*Roman Academy of Archæology*). [i]
6627. Biblioteca Vaticana (*Vatican Library*). [iii]
6629. Biblioteca Nazionale Vittorio Emanuele (*Victor Emanuel National Library*). [iii]
6631. British Academy of Fine Arts. [i]
6633. British and American Archæological Society. [i]
6635. "Bolletino Ampelografico" (*Ampelographic Bulletin*). [i]
6637. Commissione Archeologica Communale (*Archæological Commission*). [i]
6639. Comitato d' Artiglieria ed Ingegneri (*Committee of Artillery and Engineering*). [i]
6641. Corrispondenza Scientifica in Roma (*Scientific Correspondence in Rome*). [i]
6643. Direzzione della "Nuova Antologia di Scienze, Lettere ed Arti" (*The New Anthology of Science, Letters, and Arts*). [i]
6645. Direzzione del "Giornale del Genio Civile" (*Journal of Civil Engineering*). [i]
6647. Direzzione del "Periodico di Numismatica e Sfragistica per la Storia d' Italia" (*Periodical of Italian Numismatics and Engravings*). [i]
6649. Direzzione della Statistica Generale del Regno [formerly Ufficio di Statistica Generale] (*Statistical Bureau*). [i]
6651. Imperiale Istituto Archeologico Germanico (*Imperial German Archæological Institute*). [i]
[Istituto de Corrispondenza Archeologica. (Now called Imperiale Istituto Archeologico Germanico.)]
6653. Istituto Scientifico della R. Università (*Scientific Institute of the Royal University*). [i]
6655. Ministero di Agricoltura, Industria e Commercia (*Department of Agriculture, Industry, and Commerce*). [iii]
6657. Ministero della Finanze (*Department of Finance*). [i]
6659. Ministero della Guerra (*Department of War*). [i]
6661. Ministero dell' Interno (*Department of the Interior*). [i]

Roma—Continued.

6663. Ministero dell' Istruzione Pubblica (*Department of Public Instruction*). [i]
6665. Ministero dei Lavori Pubblici (*Department of Public Works*). [i]
6667. Ministero della Marina (*Department of Marine*). [i]
6669. Ministero per gli Affari Esteri (*Department of Foreign Affairs*).
6671. Museo Nazionale Prehistorico ed Etnographico (*National Prehistoric and Ethnographic Museum*). [i]
6673. Ospedali (*Hospital*). [i]
6675. Osservatorio Astronomico del Colegio Romano (*Astronomical Observatory of the Roman College*). [i]
6677. R. Accademia dei Lincei (*Royal Academy of Lincei*). [iii]
6679. R. Istituto Fisico-Patologico di Roma (*Roman Institute of Physico-Pathology*). [i]
6681. R. Comitato Geologico d' Italia (*Royal Geological Committee of Italy*). [i]
6683. R. Museo Industriale Italiano (*Royal Italian Industrial Museum*). [i]
6685. R. Orto Botanico (*Royal Botanical Garden*). [i]
6687. R. Scuola di Applicazione per gl' Ingegneri (*Royal School of Practical Engineering*). [i]
6688. R. Società Didascálica Italiana. (*Royal Didactic Society.*) [i]
6689. Revista di Filologia Romana (*Review of Roman Philology*).
6691. Società degli Spettroscopisti Italiani (*Society of Italian Spectroscopists*). [i]
6693. Società Geographica Italiana (*Italian Geographical Society*). [i]
6695. Società Italiana della Scienze (*Italian Society of Sciences*) [iii]
6697. Ufficio Centrale di Meteorologia Italiana (*Central Office of Italian Meteorology*). [i]
6698. Ufficio degli Scambi Internazionali (*Italian Bureau of International Exchanges.* [3 via del Colegio Romano. Biblioteca Nazionale, Vittorio Emanuele.] [i]

[Ufficio di Statistica Generale. (See Direzzione, &c.)]

Sienna.

6699. R. Accademia dei Fisiocritici (*Royal Academy of Critical Physiology*). [i]
6701. Osservatorio dell' Università (*University Observatory*). [i]
6703. Università (*University*). [i]
6705. Direzzione d'Artiglieria e Torpedini (*Director of Artillery and Torpedoes*). [i]

Torino (*Turin*).

6707. Accademia Reale di Agricoltura (*Royal Academy of Agriculture*). [i]
6709. Accademia Reale Medico-Chirurgica (*Royal Medico-Chirurgical Academy*). [i]
6711. Accademia Reale delle Scienze (*Royal Academy of Sciences*). [iii]
6713. Biblioteca Nazionale (*National Library*). [i]
6715. Circolo Geografico Italiano (*Italian Geographical Circle*). [i]
6717. Club Alpino (*Alpine Club*).
6719. Direzzione di "Cosmos" [Guido Cora]. [i]
6721. Direzzione de "Revista Filosofia Scientifica" [via della Scuola 5] (*Review of Philosophical Science*). [i]
6723. Museo Mineralogico di Torino (*Mineralogical Museum of Turin*).
6725. R. Accademia Albertina di Belle Arti (*Royal Albertina Academy of Fine Arts*). [i]
6727. R. Accademia di Medicina (*Royal Academy of Medicine*). [i]
6729. R. Deputazione sovra gli Studi di Storia Patria (*Royal Commission on the Study of Natural History*). [i]
6731. R. Museo Industriale Italiano di Torino (*Royal Industrial Museum of Turin*). [i]
6733. R. Museo di Storia Naturale (*Royal Museum of Natural History*). [i]
6735. R. Museo Zoologico di Torino (*Royal Zoological Museum of Turin*). [i]
6737. R. Osservatorio Astronomico dell' Università (*Royal Astronomical Observatory of the University*) [formerly Osservatorio dell' Università]. [i]
6739. R. Scuola d' Applicazione per gli Ingegneri (*Royal School of Practical Engineering*). [i]
6741. R. Scuola Superiore di Medicina Veterinaria (*Royal College of Veterinary Medicine*). [i]
6743. Scuola di Guerra (*School of War*). [i]
6745. Scuola del Stato Maggiore (*Staff School*). [i]
6747. Società degli Ingegneri e degli Industriale (*Society of Engineers and Manufacturers*). [i]
6749. Università (*University*). [i]

Treviso.

6751. Biblioteca Communale (*City Library*).
6753. R. Istituto Tecnico (*Royal Technical Institute*). [i]

Udine.

6755. Accademia di Scienze, Lettere ed Arti (*Academy of Sciences, Letters, and Arts*).

Udine—Continued.

6757. Associazione Agraria Friulana (*Friulan Agrarian Association*). [i]
6759. R. Istituto Tecnico (*Royal Technical Institute*). [i]
6761. Stazione Sperimentale Agraria (*Agrarian Experimental Station*). [i]

Urbino.

6763. Osservatorio Meteorologico (*Meteorological Observatory*). [i]

Venezia (*Venice*).

6765. Associazione Veneta di Utilità Pubblica (*Venetian Association of Public Utility*).
6767. Ateneo Veneto (*Venetian Athenæum*). [i]
6769. Biblioteca Marciana (*Marciana Library*). [iii]
6771. Biblioteca Nazionale de San Marco (*National Library of Saint Marc*). [i]
6773. Istituto Armeno dei Mechitaristi (*Mechitaristen College*). [iii]
6775. R. Accademia di Belle Arti (*Royal Academy of Fine Arts*). [i]
6777. R. Istituto Veneto di Scienze, Lettere ed Arti (*Venetian Institute of Sciences, Letters, and Arts*). [iii]
6779. Società Veneto-Trentina di Scienze Naturali (*Trentine Venetian Association of Natural Sciences*). [i]

Verona.

6781. Accademia d' Agricoltura, Commercio ed Arti di Verona (*Academy of Agriculture, Commerce, and Arts of Verona*). [iii]
6783. Biblioteca Communale (*City Library*). [i]
6785. Società Italiana delle Scienze (*Italian Society of Sciences*).

Vicenza.

6787. Accademia Olimpica di Agricoltura, Scienze, Lettere ed Arti (*Olympic Academy of Agriculture, Sciences, Letters, and Arts*). [i]
6789. Biblioteca Pubblica (*Public Library*). [i]

NETHERLANDS.

Amsterdam.

6791. Aardrijkskundig Genootschap (*Geographical Society*). [i]
6793. Commission voor de Geologische Kaart van Nederland (*Commission for the Geological Map of Netherlands*).
6795. Genootschap ter Bevordering der Natuur-, Genees- en Heelkunde (*Society for Promoting Natural, Medical, and Chirurgical Sciences*). [i]
6797. Koninklijke Akademie van Wetenschappen (*Royal Academy of Sciences*). [iii]

Amsterdam—Continued.

[Koninklijke Genootschap van Natauurkundige Wetenschappen. (See Genootschap ter Bevordering der Natuur-, Genees- en Heelkunde.)]

[Koninklijke Instituut. (See Koninklijke Akademie van Wetenschappen.)]

6799. Koninklijke Zoologisch Genootschap "Natura Artis Magistra" (*Royal Zoological Society*). [iii]

6801. "Handels-Blad" (*Journal of Commerce*).

[Landkundige Genootschap. (See Aardrijskundig Genootschap.)]

6803. Maatschappij: "Tot Bevordering der Bouwkunst" (*Society for the Encouragement of Architecture*). [iii]

6805. Maatschappij: "Tot Nut van't Algemeen" (*Society for the Benefit of all Classes*). [i]

6807. Nederlandsche Maatschappij ter Bevordering der Pharmacie (*Netherlands Association for the Promotion of Pharmacy*). [i]

6808. Revue Coloniale Internationale (*International Colonial* Review). [i]

6809. Rijks Akademie van Beeldende Kunsten (*National Academy of Fine Arts*). [i]

[Stads Bibliotheek (*City Library*). (See Universiteits Bibliotheek.)]

6811. Statistisch Instituut in Nederland (*Statistical Bureau*). [i]

6813. Universiteits Bibliotheek [formerly Stads Bibliotheek] (*University Library*). [iii]

[Vereeniging voor Statistiek. (See Statistische Instituut.)]

6815. Vereeniging voor de Flora van Nederland (*Botanical Society*).

6817. Vereeniging voor Volksvlijt (*Association for Popular Industry*). [i]

6819. "Volksvlijt:" Tijdschrift voor Nijverheid, Landbow, Handel en Scheepvaart (*Journal of Industry, Agriculture, Commerce, and Navigation*).

6821. Wiskundig Genootschap: "Onvermoeide Arbeid komt alles te boven" (*Scientific Society: "Untiring Industry Overcomes All"*). [iii]

Arnhem (*Gelderland*).

6823. Natuurkundig Genootschap: "Tot Nut en Vergenoegen" (*Natural History Society: "Utility and Amusement"*). [i]

6825. Openbare Bibliotheek (*Public Library*). [i]

Bois-le-Duc.

[Société des Arts et Sciences. (See 'S Hertogenbosch.)]

Breda (*Noord Braband*).

6827. Koninklijke Militaire Akademie (*Royal Military Academy*). [i]

Delft.

6829. Polytechnische School (*Polytechnic School*). [i]

Deventer (*Overyssel*).

6831. Openbare Bibliotheek (*Public Library*). [i]

'S Gravenhage [*The Hague*] (*Zuid Holland*).

6833. Board of Fisheries.
6835. Bureau voor Statistiek (*Statistical Bureau*). [i]
6837. Commission Géodésique Néerlandaise (*Geodetic Commission*).
6839. Haagsche Genootschap tot Verdediging van den Christlijken Godsdienst (*Haagsch Society for the Vindication of the Christian Religion*). [i]
6841. Institut Topographique (*Topographical Institute*).
6843. Koninklijk Bibliotheek (*Royal Library*). [iii]
6845. Koninklijk Instituut van Ingenieurs (*Royal Institute of Engineers*). [iii]
6847. Koninklijk Instituut voor de Taal-, Land- en Volkenkunde van Nederlandsch Indië (*Royal Institute for Philology, Geography, and Ethnography of Dutch India*). [iii]
6849. Koninklijk Zoologisch-Botanische Genootschap te 'S Gravenhage (*Royal Zoological Botanical Society of the Hague*). [i]
6851. Library of the States General.
6853. Ministère de l'Intérieur (*Department of the Interior*).
[Nederlandsche Entomologische Vereeniging. (See Leiden.)]
6855. Nederlandsche Regeering (*Government of the Netherlands*). [i]

Groningen.

[Academia Groningana. (See Rijks Universiteit.)]
6857. Genootschap pro excolendo Jure Patrio (*Society for the Cultivation of National Jurisprudence*). [i]
6859. Instituut voor Doofstommen (*Institution for the Deaf and Dumb*). [i]
6861. Natuurkundig Genootschap (*Natural History Society*). [i]
6863. Rijks Universiteit (*National University*) [formerly Academia Groningana]. [iii]

Haarlem (*Noord Holland*).

6865. Archives Néerlandais (*Netherlands Archives*). [i]
[Bataviaasch Genootschap (*Batavian Society*).] [i]
6867. Fondation de P. Teyler van der Hulst (*Teyler Institution*). [i]

Haarlem (*Noord Holland*)—Continued.

6869. Hollandsche Maatschappij van Wetenschappen (*Holland Society of Sciences*). [iii]

[Ministère de l'Intérieur—in 'S Gravenhage].

6871. Nederlandsche Maatschappij ter Bevordering van Nijverheid (*Society for the Promotion of Industry*). [i]

[Openbare Bibliotheek. (See Stads Bibliotheek.)]

6873. Stads Bibliotheek (*City Library*). [iii]

'S Hertogenbosch (*Noord Brabant*).

6875. Provinciaal Genootschap van Kunsten en Wetenschappen in Noord Braband (*Provincial Society of Arts and Sciences in North Brabant*). [i]

Hoorn (*Noord Holland*).

6877. Societas Medico-Physica Hornana (*Medico Physical Society of Hoorn*). [i]

[Cercle Agricole et Horticole (*Agricultural and Horticultural Society.*)]

[**Luxembourg.** (See under Germany.)]

Leeuwarden (*Friesland*).

6879. Friessch Genootschap voor Geschied-, Oudheid en- Taalkunde (*Friesland Society of History, Antiquity, and Philology*). [i]

Leiden (*Zuid Holland*).

6881. Bureau Scientifique Central Néerlandais (*Central Scientific Bureau*) [Haarlemmer Straat 12]. [i]

[Academia Lugduno-Batava. (See Rijks Universiteit.)]

6883. Maatschappij van Nederlandsche Letterkunde (*Society of the Literature of the Netherlands*). [i]

6885. "Mnemosyne."

6887. Nederlandsche Botanische Vereeniging (*Netherlands Botanical Society*). [i]

6889. Nederlandsche Dierkundige Vereeniging (*Netherlands Zoological Society*). [i]

6891. Nederlandsche Entomologische Vereeniging (*Netherlands Entomological Society*). [i]

6893. Rijks Ethnographisch Museum (*Royal Ethnographical Museum*). [i]

6895. Rijks Museum van Natuurlijke Historie (*Royal Museum of Natural History*). [i]

6897. Rijks Museum van Oudheden (*Royal Museum of Antiquities*). [i]

6899. Rijks Observatorium (*Royal Observatory*). [i]

6901. Rijks Herbarium (*Royal Herbarium*). [i]

Leiden (*Zuid Holland*)—Continued.

6903. Rijks Universiteit (*Royal University*). [iii]
6905. Stolpiaansch Legaat (*Stolp's Legacy*). [i]
[Universitas Lugduno-Batava. (See Rijks Universiteit.)]
6907. Tijdschrift voor Entomologie (*Entomological Journal*).
6909. Zoologisch Station der Nederlandsche Dierkundige Vereeniging (*Netherlands Zoological Garden*).

Maastricht.

6911. Provinciaal Bureau van Statistiek (*Provincial Bureau of Statistics*).
6913. Vereeniging ter Bevordering van Tuin en Landbouw (*Association for the Promotion of Horticulture and Agriculture*). [i]

Middelburg (*Zealand*).

6915. Zeeuwsch Genootschap van Wetenschappen (*Zealand Society of Sciences*). [iii]
6917. Provinciaale Bibliotheek van Zeeland (*Provincial Library of Zealand*). [i]

Rotterdam (*Zuid Holland*).

6919. Bataafsch Genootschap van Proefondervindelijke Wijsbegeerte (*Batavian Society of Experimental Philosophy*). [iii]
6921. Inrigting voor Doofstommen Onderwijs (*Institute for the Deaf and Dumb*). [i]
6923. Lees Kabinet (*Reading Room*).
[Nederlandsche Yacht Club (*Netherlands Yacht Club*).]
6925. Société Néerlandaise de Zoologie (*Netherlands Zoological Society*).

Schiedam (*Zuid Holland*).

6926. Natuurkundige Vereeniging "Martinet" ("*Martinet*" *Society of Natural Sciences*). [i]

Utrecht.

[Academia Rheno-Trajectina. (See Rijks Universiteit.)]
6927. Archiv für Holländische Beiträge zur Natur- und Heilkunde (*Archives of Holland Contributions to Natural and Medical Sciences*). [i]
6929. Historisch Genootschap (*Historical Society*). [iii]
6931. Koninklijk Nederlandsche Meteorologisch Instituut (*Royal Dutch Meteorological Institute*). [i]
6933. Observatorium (*Observatory*). [i]
6935. Physiologisch Laboratorium (*Physiological Laboratory*). [i]
6937. Provinciaal Utrechtsch Genootschap van Kunsten en Wetenschappen (*Provincial Society of Arts and Sciences*). [iii]

Utrecht—Continued.

6939. Rijks Veeartsenijschool (*Royal Veterinary School*). [i]
6941. Rijks Universiteit (*Royal University*). [iii]
[Utrechtsche Hoogeschool. (See Rijks Universiteit.)]

Zwolle (*Overijssel*).

6943. Overijsselsche Vereeniging tot Ontwikkeling van Provinciaale Welvaart (*Overyssel Society for the Promotion of Provincial Welfare*). [iii]
6945. Vereening tot Beoefening van Overijsselsch Regt en Geschiedenis (*Society for the Cultivation of Overyssel Jurisprudence and History*). [i]
6947. "Vriend van den Landman" ("*Friend of the Agriculturist*"). [i]

Wageningen.

6949. Landbouw School (*Agricultural School*).

NORWAY.

Arendal.

6951. Arendals Skoles offentlige Bibliothek og Museum (*Free Public Library and Museum*). [i]
[Arendals Museum. (See Arendals Skoles offentlige Bibliothek og Museum.)]

Bergen.

[Archiv for Mathematik og Naturvidenskab. (In Christiania.)]
6953. Bergen Museum (*Bergen Museum*). [iii]
6955. Bergens Offentlige Bibliothek (*Bergen Free Library*).
6957. Medicinske Revue ([*Monthly*] *Medical Review*).
6959. Observatoriet ([*Astronomical and Nautical*] *Observatory*). [i]
6961. Selskabet for de Norske Fiskeries Fremme (*Association for the Promotion of the Norwegian Fisheries*). [i]

Christiania.

[Afdeling for Geologiske Undersögelse. (See Den Geologiske Undersögelse.)]
[Archæological Museum. (See Det Kongelige Norske Frederiks Universitet.)]
6963. Archiv for Mathematik og Naturvidenskab (*Archives of Mathematics and Natural Sciences*). [i]
6965. Archiv for Nordisk Filologie (*Archives of Northern Philology*). [i]
[Association Géodésique Internationale. (See Den Norske Gradmaalings Kommission.)]
6967. Den Geographiske Opmaaling (*Royal Coast and Geographical Survey*). [i]

Christiania—Continued.

6969. Den Geologiske Undersögelse (*Royal Geological Survey*). [i]
6971. Den Norske Forstforening (*The Norwegian Association of Forestry*). [i]
6973. Den Norske Gradmaaling Kommission (*The Norwegian Geodetic Commission*). [i]
6975. Den Norske Historiske Forening (*The Norwegian Historical Association*). [i]
6977. Den Norske Ingeniör og Architekt Forening (*Society of Norwegian Engineers and Architects*). [i]
6979. Den Norske Turist Forening (*Alpine Club of Norway*). [i]
[Departementet for det Indre. (See Indre Departementet.)]
6981. Det Kongelige Norske Kirke og Undervisnings Departementet (*Royal Norwegian Department of Worship and Education*). [i]
6983. Det Kongelige Norske Frederiks Universitet (*Royal Norwegian Frederick University*). [iii]
6985. ——— Astronomical Observatory. [i]
6987. ——— Collection of Coins and Medals.
6989. ——— Laboratory of Chemistry.
6991. ——— Library of the University.
6993. ——— Museum of Anatomy.
6995. ——— Museum of Botany.
6997. ——— Museum of Ethnological Objects and National Ethnography.
6999. ——— Museum of Old Northern Antiquities.
7001. ——— Museum of Zoology.
7003. Det Norske Medicinske Selskab (*The Norwegian Medical Society*). [i]
7005. Det Meteorologiske Institut (*Meteorological Office*). [i]
7007. Det Norske Samlag (*The Norske Society*).
7009. Det Statistiske Centralbureau (*Statistical Bureau*). [i]
7011. Foreign Office. [i]
7013. Forening for Dialekter og Folketraditioner (*Association for Norwegian Dialect and Folklore*).
7015. Forening til Norske Fortidsmindersmerkers Bevaring (*Association for the Preservation of Old Norske Antiquities and Monuments*). [i]
7017. Generalfelttöjmestern (*Great Master of the Ordnance*).
7019. Indre Departementet (*Department of the Interior*). [i]
[Institution géographique de Norvège et la section topographique de l'état major général (*Geographical Institute &c.*). (See Den Geografiske Opmaaling.)]
7021. Kongelige Bibliothek (*Royal Library*). [i]
[Kongelige Selskabet for Norges Vel. (See Selskab for Norges Vel.)]

Christiania—Continued.

7023. Kristiania Blinde Institut (*Christiania Institution for the Blind*). [i]

[Mediciniske Selskab. (See Det Norske Medicinske Selskab.)]

7025. Militaere Samfund (*Military Society*). [i]

7027. "Naturen" (*Nature*). [i]

7029. Nordhavse Expeditionens Redactions Comite (*Public Committee of the Norwegian North Atlantic Expedition*). [i]

[Norges Geografiske Opmaaling. (*See* Den Geographiske Opmaaling.)]

[Norske Historiske Forening (*Norwegian Historical Society*). (See Den Norske Historiske Forening.)]

[Norske Meteorologiske Institut. (See Det Meteorologiske Institut.)]

7031. Norske Oldskrift Selskab (*Norwegian Antiquarian Society*). [i]

7033. Norsk Retstidende (*Review of Laws and Sentences of the Supreme Court*).

7035. Norske Sagförer Forening (*Norwegian Lawyers' Society*). [i]

[Norske Tourist Forening. (See Den Norske Turist Forening.)]

7037. Nyt Magazin for Naturvidenskabernes (*Quarterly Magazine of Natural Sciences*). [i]

[Physiographiske Forening. (Dissolved.)]

7039. Polytekniske Forening (*Polytechnic Society*). [i]

[Parliamentary Library. (See Storthingets Bibliothek.)]

7041. Rigsarkivet (*The Royal Archives of Norway*). [i]

7043. Rigshospitalet (*Royal Infirmary*).

7045. Selskabet for Folkeoplysningens Fremme (*Society for the Promotion of Knowledge*).

7047. Selskab for Norges Vel (*Royal Society for the Promotion of the Wealth of Norway*). [i]

7049. Selskabet for Norges Fiskeries (*Norwegian Fishery Society*). [i]

[Satistiske Central Bureau. (See Det Statistiske Centralbureau.)]

7051. Storthingets Bibliothek (*Parliamentary Library*). [i]

7053. Theologiske Forening (*Theological Society*).]i]

7055. Theologisk Tidsskrift (*Quarterly Journal of Theology*). [i]

7057. Tidskrift for Praktisk Medicin (*Fortnightly Review of Practical Medicine*). [i]

[Topografiske og Hydrografiske Afdeling. (See Den Geographiske Opmaaling.)]

[Universitets Observatoriet. (See K. N. Fred. Universitet.)]

7059. Videnskabs Selskabet (*Academy of Sciences*). [i]

Christiansand.

7061. Kathedralskolens Offentlige Bibliothek (*Free Public Library of the Cathedral School*). [i]

Frederikshald.

7063. Frederikshald Stadsbibliothek (*Free Town Library*). [i]

Horten.

7065. Sömilitaere Samfund (*Society of Naval Officers*). [i]

Stavanger.

7067. Det Norske Missions Selskab (*Norwegian Missionary Society [for the Promotion of Christianity among the Pagan Tribes of South Africa and Madagascar]*). [i]
7069. Free Public Library. [i]
7071. Stavanger Museum (*Museum of Zoology and Antiquities*).

Trondhjem.

7073. Det Kongelige Norske Videnskabernes Selskab (*Royal Norwegian Society of Sciences*). [iii]

Tromsö.

7075. Tromsö Kommunale Bibliothek (*Tromsö Free Town Library*).
7077. Tromsö Museum (*Tromsö Museum*). [i]

PORTUGAL.

Coïmbra.

7079. Effemerides Astronomicas (*Astronomical Ephemeris*). [i]
7081. Instituto de Coïmbra (*Institute of Coimbra*). [i]
7083. Observatorio Magnetico-Meteorologico da Universidade de Coïmbra (*Magnetic and Meteorological Observatory of the University of Coimbra*). [i]
7085. Universidade (*University*). [i]

Evora.

7087. Biblioteca Publica (*Public Library*). [i]

Lisbôa (*Lisbon*).

7089. Academia Real des Sciencias (*Royal Academy of Sciences*). [iii]
7091. Academia des Bellas Artes (*Academy of Fine Arts*). [i]
7093. Associação dos Engenheiros Civis Portuguezes (*Association of Portuguese Civil Engineers*). [i]
7095. Biblioteca Nacional (*National Library*). [iii]
7097. Colonial Department of the Navy Department.
7099. Commissão Central Permanente de Geographia (*Central Permanent Commission of Geography*). [i]

[Commissão Geologica de Portugal. (See Direcção General dos Trabalhos Geologicos.)]

Lisböa (*Lisbon*)—Continued.

7101. Direcção General dos Trabalhos Geodesicos (*Geodetic Office*). [i]
7103. Direcção General dos Trabalhos Geologicos (*Geological Bureau*). [i]
7105. Escola da Exercito (*Military School*). [i]
7107. Escola Medico-Cirurgica (*Medico-Chirurgical School*). [i]
7109. Escola Naval (*Naval School*). [i]
7111. Escola Polytechnica (*Polytechnical School*). [i]
7113. Instituto Industrial de Lisböa (*Industrial Institute*). [i]
7115. Instituto Real de Agricultura (*Royal Institute of Agriculture*). [i]
7117. Ministro de Negocios Estrangeiros (*Minister of Foreign Affairs*). [i]
7119. Museo de Lisböa (*Lisbon Museum*). [i]
7121. Museo Nacional das Colonias (*National Museum of the Colonies*). [i]
7123. Observatorio Astronomico da Tapada de Alcantara (*Astronomical Observatory of Tapada of Alcantara*). [i]
7125. Observatorio Astronomico na Escola Polytechnica (*Astronomical Observatory of the Polytechnical School*). [i]
7127. Observatorio de Marina (*Naval Observatory*). [i]
7129. Observatorio Meteorologico do Infante Dom Luiz na Escola Polytechnica (*Infant Dom Luiz Meteorological Observatory of the Polytechnic School*). [i]
7131. Real Associação Central de Agricultura Portugueza (*Royal Central Association of Portuguese Agriculture*). [i]
7133. Real Conservatorio de Musica (*Royal Conservatory of Music*).
7135. Sociedade de Geografia (*Geographical Society*). [i]
7137. Sociedade dos Architectos e Archeologos (*Society of Architects and Archæologists*). [i]
7139. Sociedade Archeologica de Lisböa (*Archæological Society of Lisbon*).
7141. Sociedade Promotora da Industria Falevil (*Society for the Promotion of Manufacturing Industry*). [i]
7143. Sociedade Pharmaceutica Lusitania (*Lisbon Pharmaceutical Society*). [i]
7145. Sociedade des Sciencias Medicas de Lisböa (*Lisbon Society of Medical Sciences*). [i)

Oporto.

7147. Academia Polytechnica (*Polytechnic Academy*). [i]
7149. "Centro Pharmaceutico Portugueze" ("*Pharmaceutical Centre*"). [i]
7151. Escola Medico-Cirurgica (*Medico-Chirurgical School*) [i]
7153. Instituto Industrial (*Industrial Institute*). [i]

Oporto—Continued.

7155. Museo de Historia Natural da Camara Municipal do Porto (*Oporto Museum of Natural History*). [i]

7157. Sociedade de Instrucção do Porto (*Educational Society*). [Packages sent through Ramsay Crooks, Esq., 25 South William Street, New York.] [i]

7159. Sociedade Portugueza de Geografia (*Portuguese Geographical Society*).

ROUMANIA.

Bukarest.

7161. Société Roumaine d'Agriculture (*Roumanian Agricultural Society*). [i]

7163. Société Roumaine de Géographie (*Roumanian Geographical Society*).

RUSSIA.

Arkhangel.

7165. Flotskaia Biblioteka (*Naval Library*).

Barnäul.

7167. Meteorologicheskaia Observatoria (*Meteorological Observatory*). [i]

Derpt (*Dorpat*).

7169. Derptskoie Obshchestvo Iestesto-Ispytalelei (*Dorpat Society of Naturalists*). [i]

7171. Farmatsevticheskoie Obshchestvo (*Pharmaceutical Society*). [i]

7173. Imper. Astronomicheskaia Observatoria [Kaiserliche Universitäts-Sternwarte] (*Imperial Astronomical Observatory*). [i]

7175. Imper. Universitet (*Imperial University*). [iii]

7177. Kaiserliche Livländische Oekonomische Gesellschaft (*Imperial Livonian Economical Society*). [i]

7179. Meteorologicheskaia Observatoria (*Meteorological Observatory*). [i]

7181. Statistisches Bureau der Universität (*Statistical Bureau of the University*). [i]

7183. Uchonoie Estonskoie Obshchestvo [Gelehrte Estnische Gesellschaft] (*Esthonian Scientific Society*). [iii]

7185. Veterinarnyi Institut (*Veterinary Institute*). [i]

Ekaterinburg.

7187. Meteorologicheskaia Observatoria (*Meteorological Observatory*). [i]

7189. Société Ouralienne d'Amateurs des Sciences Naturelles (*Uralian Society of Friends of Natural Science*).

Helsingfors.

7191. Bureau Central de Statistique de la Finlande (*Central Statistical Bureau of Finland*).

7193. Finnische Akademie der Wissenschaften (*Finnish Academy of Sciences.*)

7195. Finska Geologiska Undersökningen (*Geological Survey of Finland*). [i]

7197. Finska Litteratur-Sällskapet (*Society of Finnish Literature*). [i]

7199. Finskoie Uchonoie Obshchestvo [Societas Scientiarum Fennica, Finska Vetenskaps-Societet] (*Finnish Scientific Society*). [iii]

7201. Kejserliga Alexanders-Universitet i Finland (*Imperial Alexander University of Finland*). [Packages sent through F. A. Brockhaus, Leipzig.] [i]

7203. Magnitnaia i Meteorologicheskaia Observatoria (*Magnetic and Meteorological Observatory*). [i]

7205. Obshchestvo Finlandskih Vrachei [Finska Läkare Sällskapet] (*Society of Physicians of Finland*). [i]

7207. Sällskapet pro Fauna et Flora Fennica (*Society for the Fauna and Flora of Finland*). [i]

Iaroslavl (*Yaroslav*).

7209. Demidofskii Iuridicheskii Litsei (*Demidof Juridical Lyceum*). [i]

7211. Obshchestvo dla izsledovania Iaroslafskoi gubernii v iestestvenno-istoricheskom otnoshenii (*Society for Investigating the Natural History of the District of Iaroslavl*). [i]

Irkutsk.

7213. Vostochno-Sibirskii Otdiel Imper. Russkavo Geograficheskavo Obshchestva (*East-Siberian Section of the Imperial Russian Geographical Society*). [i]

Kazan.

7215. Imper. Kazanskii Universitet (*Imperial University of Kazan*). [iii]

7217. Imper. Kazanskoie Ekonomicheskoie Obshchestvo (*Imperial Economical Society of Kazan*). [i]

7219. Kazanskoie Obshchestvo Vrachei (*Society of Physicians of Kazan*).

7221. Observatoria (*Observatory*). [i]

7223. Obshchestvo Iestestvo-Ispytatelei pri Imper. Kazanskom Universitetie (*Society of Naturalists at the Imperial University of Kazan*). [i]

Kharkof.

7225. Imper. Kharkofskii Universitet (*Imperial University of Kharkof*). [i]

Kharkof—Continued.

7227. Mathematische Gesellschaft der Universität (*Mathematical Society of the University*).

7229. Obshchestvo Ispytatelei Prirody pri Imper. Kharkofskom Universitetie (*Society of Naturalists at the Imperial University of Kharkof*). [i]

7231. Veterinarnoie Uchilishche (*Veterinary School*). [i]

Kief.

7233. Imper. Universitet Sviatovo Vladimira (*Imperial St. Vladimir University*). [i]

7235. Kiefskoie Obshchestvo Iestestvo-Ispytatelei (*Kief Society of Naturalists*). [i]

7237. Observatoria (*Observatory*). [i]

Kronshtat (*Cronstadt*).

7239. Kompasnaia Observatoria (*Compass Observatory*). [i]

7241. Kronshtatskaia Morskaia Biblioteka (*Naval Library of Cronstadt*). [i]

7243. Morskaia Astronomicheskaia Observatoria (*Naval Astronomical Observatory*). [i]

7245. Obshchestvo Morskih Vrachei (*Society of Naval Physicians*). [i]

Lebedian (*District of Tambof*).

[Lebedianskoie Obshchestvo Selskovo Hoziaistva (*Lebedian Society of Rural Economy*). (Closed.)]

Lugan (*District of Ekaterinoslav'*).

7247. Meteorologicheskaia Observatoria (*Meteorological Observatory*).

Mitava (*Mitau*).

7249. Kurlandskoie Obshchestvo Literatury i Iskusstv (*Courland Society of Literature and Art*). [iii]

Moskva (*Moscow*).

7251. Chertkofskaia Publichnaia Biblioteka (*Chertkof Public Library*). [i]

7253. Etnograficheskii Muzei (*Ethnographical Museum*). [i]

7255. Fiziko-Meditsinskoie Obshchestvo (*Physico-Medical Society*). [i]

7257. Imper. Moskofskii Universitet (*Imperial University of Moscow*). [i]

7259. Imper. Moskofskoie Obshchestvo Iestestvo-Ispytatelei (*Imperial Moscow Society of Naturalists*). [iii]

7261. Imper. Moskofskoie Obshchestvo Selskovo Hoziaistva (*Imperial Moscow Society of Rural Economy*). [i]

7263. Imper. Obshchestvo Istorii i Drevnostei Rossiiskih pri Moskofskom Universitetie (*Imperial Society of Russian History and Antiquities at the University of Moscow*). [i]

Moskva (*Moscow*)—Continued.

7265. Imper. Obshchestvo Lubitelei Iestestvoznania, Antropologii i Etnografii (*Imperial Society of Friends of Natural Science, Anthropology, and Ethnography*). [i]

7267. Imper. Zemledielcheskoie Obshchestvo v Moskvie (*Imperial Agricultural Society of Moscow*). [i]

7269. Iuridicheskoie Obshchestvo (*Juridical Society*). [i]

7271. Kommercheskaia Akademia (*Commercial Academy*). [i]

7273. Lazarefskii Institut Vostochnyh Iazykof (*Lazaref Institute of Oriental Languages*). [i]

7275. Meteorological Observatory of the Agricultural Academy.

7277. Moskofskaia Synodalnaia Biblioteka (*Moscow Synodal Library*).

7279. Moskofskii Publichnyi i Rumiantsefskii Muzei (*Moscow Public and Rumiantsef Museums*). [i]

7281. Moskofskoie Archeologicheskoie Obshchestvo (*Moscow Archæological Society*). [i]

7283. Moskofskoie Matematicheskoie Obshchestvo (*Moscow Mathematical Society*). [i]

7285. Muzei Kniazia Sergeia Mihailovicha Galitsyna (*Prince Sergius Galitsyn's Museum*). [i]

7287. Observatoria (*Observatory*). [i]

7289. Obshchestvo Akklimatizatsii Rastenii i Zhivotnyh (*Society of Acclimation of Plants and Animals*). [i]

7291. Obshchestvo Drevne-Russkavo Iskusstva pri Moskofskom Publichnom i Rumiantsefskom Museiah (*Society of Old Russian Art at the Moscow Public and Rumiantsef Museums*). [i]

7293. Obshchestvo Lubitelei Hudozhestv (*Society of Friends of the Fine Arts*). [i]

7295. Obshchestvo Lubitelei Rossiiskoi Slovesnosti (*Society of Friends of Russian Literature*). [i]

7297. Petrofskaia Zemledielcheskaia i Lesnaia Akademia (*Peter Academy of Agriculture and Forestry*). [i]

[Rumiantsefskaia Biblioteka i Muzei (*Rumiantsef Library and Museum*). (See Moskofskii Publichnyi i Rumiantsefskii Musei.)]

7299. Russkoie Obshchestvo Lubitelei Sadovodstva (*Russian Society of Friends of Horticulture*). [i]

[Slavianskii Komitet (*Slavic Committee*). (Closed.)]

Narva.

7301. Narvskoie Arheologicheskoie Obshchestvo (*Archæological Society of Narva*). [i]

Nerchinsk.

7303. Meteorologicheskaia Observatoria (*Meteorological Observatory*). [i]

Nezhin.

7305. Istoriko-Filologicheskii Institut (*Historico-Philological Institute*) [formerly Litsei Grafa Bezborodko]. [i]

Nikolaief.

7307. Observatoria (*Observatory*). [i]

Odessa.

7309. Gorodskaia Publichnaia Biblioteka (*Public City Library*). [i]
7311. Imper. Novo-Rossiiskii Universitet (*Imperial New-Russian University*).
7313. Imper. Obshchestvo Selskova Hoziaistva Iuzhnoi Rossii (*Imperial Society of Rural Economy of Southern Russia*). [i]
7315. Novo-Rossiiskoie Obshchestvo Iestestvo-Ispytatelei (*New-Russian Society of Naturalists*). [The library of this society is inseparably connected with the university.]
7317. Odesskoie Obshchestvo Istorii i Drevnostei (*Historical and Antiquarian Society of Odessa*). [i]

[Publichnaia Biblioteka (*Public Library*). (See Gorodskaia Publichnaia Biblioteka.)]

7319. Société de Médecine d'Odessa (*Medical Society of Odessa*). [i]
7321. Uchilishche Gluho-Niemyh (*Deaf and Dumb Institution*). [i]

Omsk.

7323. Obshchestvo Izsledovatelei Zapadnoi Sibiri (*Society of Explorers of Western Siberia*). [i]

Orenburg.

7325. Orenburgskii Otdiel Imper. Russkavo Geograficheskavo Obshchestva (*Orenburg Section of the Imperial Russian Geographical Society*). [i]

Pavlofsk.

7327. Library of the Meteorological and Magnetic Station.

Pulkovo (*Poulkova*).

7329. Nikolaiefskaia Glavnaia Observatoria (*Nicholas Chief Observatory*). [i]

Revel (*Reval*).

7331. Estlandskoie Literaturnoie Obshchestvo (*Esthonian Literary Society*). [i]

Riazan.

7333. Publichnaia Biblioteka (*Public Library*). [i]

Riga.

7335. Lettisch-Literärische Gesellschaft (*Society of Lettic Literature*). [i]
7337. Muzei (*Museum*). [i]
7339. Obshchestvo Iestestvo-Ispytatelei [Naturforscherverein] (*Society of Naturalists*). [iii]

Riga—Continued.

7341. Obshchestvo Istorii i Drevnostei Russkih Pribaltiiskih Provintsii [Gesellschaft für Geschichte und Alterthumskunde der Ostsee-Provinzen Russlands] (*Historical and Antiquarian Society of the Russian Baltic Provinces*). [i]

7343. Obshchestvo Prakticheskih Vrachei (*Society of Practical Physicians*). [i]

7345. Technicheskoie Obshchestvo (*Technical Society*). [i]

Sankt-Peterburg (*St. Petersburg*).

7347. Ievo Velichestvo Imperator Vserossiiskii (*His Majesty the Emperor of Russia*). [iii]

7349. Arheograficheskaia Kommissia pri Ministerstvie Narodnavo Prosvieshchenia (*Archæographical Commission of the Ministry of Public Education*). [i]

7351. Bibliothek der Evangelischen Gemeinden in St. Petersburg (*Library of the Protestant Congregations of St. Petersburg*).

7353. Cabinet der Physikalischen Geographie der Kaiserlichen Universität (*Cabinet of Physical Geography of the Imperial University*). [i]

7355. Commission pour fixer les mesures et les poids de l'Empire de Russie (*Commission for establishing measures and weights in the Russian Empire*).

7357. Commission russe des échanges internationaux de la Bibliothèque Impériale Publique (*Russian Commission of International Exchanges at the Imperial Public Library*). [i]

7359. Filologicheskoie Obshchestvo pri Sankt-Peterburgskom Universitetie (*Philological Society of the University of St. Petersburg*). [i]

7361. Geologicheskii Komitet (*Geological Committee*). [i]

7363. Gidrograficheskii Departament Morskovo Ministerstva (*Hydrographical Department of the Ministry of Marine*). [iii]

7365. Gornaia Akademia (*Mining Academy*). [i]

7367. Gornyi Departament Ministerstva Gosudarstvennyh Imushchestv (*Mining Department of the Ministry of State Domains*). [i]

7369. Gosudarstvennaia Kommissia Pogashenia Dolgof (*Imperial Commission of Amortizement*).

7371. Imper. Akademia Nauk (*Imperial Academy of Sciences*). [iii]

7373. Imper. Aleksandrofskii Litsei (*Imperial Alexander Lyceum*). [i]

7375. Imper. Arheologicheskaia Kommissia (*Imperial Archæological Commission*). [iii]

Sankt-Peterburg (*St. Petersburg*)—Continued.

7377. Imper. Farmatsefticheskoie Obshchestvo (*Imperial Pharmaceutical Society*). [i]
7379. Imper. Istoriko-Filologicheskii Institut (*Imperial Historico-Philological Institute*). [i]
7381. Imper. Mediko-Hirurgicheskaia Akademia (*Imperial Medico-Surgical Academy*). [i]
7383. Imper. Mihailofskaia Artilleriiskaia Akademia (*Imperial Michael Artillery Academy*). [i]
7385. Imper. Nikolaiefskaia Inzhenernaia Akademia (*Imperial Nicholas Engineering Academy*). [i]
7387. Imper. Nikolaiefskaia Voiennaia Akademia (*Imperial Nicholas Military Academy*).
7389 Imper. Publichnaia Biblioteka (*Imperial Public Library*). [iii]
7391. Imper. Rossiiskoie Obshchestvo Sadovodstva v Sankt-Peterburgie (*Imperial Russian Horticultural Society of St. Petersburg*). [i]
7393. Imper. Russkoie Arheologicheskoie Obshchestvo (*Imperial Russian Archæological Society*). [i]
7395. Imper. Russkoie Geograficheskoie Obshchestvo (*Imperial Russian Geographical Society*). [iii]
7397. Imper. Russkoie Istoricheskoie Obshchestvo (*Imperial Russian Historical Society*). [i]
7399. Imper. Russkoie Tehnicheskoie Obshchestvo (*Imperial Russian Technical Society*). [i]
7401. Imper. Sankt-Peterburgskaia Akademia Hudozhestv (*Imperial St. Petersburg Academy of Fine Arts*).
7403. Imper. Sankt-Peterburgskii Botanicheskii Sad (*Imperial Botanical Garden of St. Petersburg*). [Packages sent through Wm. Mintor, Wandrahm Brücke 6, Hamburg, Germany.] [i]
7405. Imper. Sankt-Peterburgskii Universitet (*Imperial University of St. Petersburg*). [i]
7407. Imper. Sankt-Peterburgskoie Mineralogicheskoie Obshchestvo (*Imperial Mineralogioal Society of St. Petersburg*). [iii]
7409. Imper. Tehnologicheskii Institut (*Imperial Technological Institute*). [i]
7411. Imper. Uchilishche Gluho-Niemyh (*Imperial Deaf and Dumb Institute*). [i]
7413. Imper. Uchilishche Pravoviedenia (*Imperial Law School*).
7415.*Imper. Volnoie Ekonomicheskoie Obshchestvo (*Imperial Free Economical Society*). [iii]
7417. Institut Korpusa Putei Soobshchenia (*Institution of the Corps of Engineers*). [i]

Sankt-Peterburg (*St. Petersburg*)—Continued.

7419. Institut Slepyh (*Institution for the Blind*). [i]

[Lesnaia Akademia. (See Sankt-Peterburgskii Lesnoi Institut.)]

7421. Medicinische Wochenschrift (*Medical Weekly*). [Dr. E. Moritz.] [i]

7423. Meditsinskii Departament Morskovo Ministerstvo (*Medical Department of the Ministry of Marine*). [i]

7425. Ministerstvo Finansof (*Ministry of Finance*). [i]

7427. Ministerstvo Gosudarstvennyh Imushchestv (*Ministry of State Domains*).

7429. Ministerstvo Narodnavo Prosvieshchenia (*Ministry of Public Education*). [i]

7431. Ministerstvo Putei Soobshchenia (*Ministry of Ways of Communication*). [i]

7433. Ministerstvo Vnutrennih Diel (*Ministry of the Interior*).

7435. Morskaia Akademia (*Naval Academy*). [i]

7437. Morskoie Ministerstvo (*Ministry of Marine*). [i]

7439. Morskoi Muzei (*Naval Museum*). [i]

7441. Morskoi Uchonyi Komitet (*Scientific Committee of the Navy*). [i]

7443. Muzei Grecheskih i Rimskih Drevnostei (*Museum of Greek and Roman Antiquities*). [i]

[Musée Impérial Agronomique. (See Zemledielcheskii Institut.]

7445. Muzei Imper. Akademii Nauk (*Museum of the Imperial Academy of Sciences*). [i]

7447. Muzei Imper. Ermitazha (*Museum of the Imperial Hermitage*). [i]

7449. Muzei Instituta Korpusa Gornyh Inzhenerof (*Museum of the Corps of Mining Engineers*). [i]

7451. Nikolaiefskaia Akademia Generalnavo Shtaba (*Nicholas Academy of the General Staff*). [i]

7453. Observatoire de l'Université Impériale (*Observatory of the Imperial University*). [i]

7455. Observatoria Astronomicheskaia pri Imper. Akademii Nauk (*Astronomical Observatory of the Imperial Academy of Sciences*). [i]

[Obshchestvo Estestvo Ispytateley pro Sankt-Peterburgskom Vniversitete. (See Sankt-Peterburgskoie Obshchestvo Iestestvo-Ispytatelei.)]

7457. Obshchestvo Morskih Vrachei (*Society of Naval Physicians*). [i]

[Pedagogicheskoie Obshchestvo (*Pedagogical Society*). (Closed.)]

7459. Russiche Revue (*Russian Review*).

Sankt-Peterburg (*St. Petersburg*)—Continued.

7461. Russkoie Entomologicheskoie Obshchestvo (*Russian Entomological Society*). [i]

7463. Russkoie Himicheskoie Obshchestvo pri Sankt-Peterburgskom Universitetie (*Russian Chemical Society of the St. Petersburg University*). [i]

7465. Sankt-Peterburgskaia Gorodskaia Duma (*City Council of St. Petersburg*).

7467. Sankt-Peterburgskii Lesnoi Institut (*St. Petersburg Institute of Forestry*).

[Sankt-Peterburgskii Otdiel Slavianskavo Komiteta (*St. Petersburg Section of the Slavic Committee*). (Closed.)]

7469. Sankt-Peterburgskoie Obshchestvo Iestestvo-Ispytatelei (*St. Petersburg Society of Naturalists*). [i]

7471. Sankt-Peterburgskoie Slavianskoie Blagotvoritelnoie Obshchestvo (*Slavic Benevolent Society of St. Petersburg*). [i]

7473. Selsko-hoziaistvennyi Muzei (*Museum of Rural Economy*). [i]

7475. Shtab Korpusa Gornyh Inzhenerof (*Staff of the Corps of Mining Engineers*). [iii]

7477. Topograficheskoie Buro Voiennavo Ministerstva (*Topographical Bureau of the Ministry of War*). [i]

7479. Tsentralnaia Fizicheskaia Observatoria (*Central Physical Observatory*). [iii]

7481. Tsentralnyi Statisticheskii Komitet Ministerstva Vnutrennih Diel (*Central Statistical Committee of the Ministry of the Interior*). [i]

7483. Uchebnoie Otdielenie Vostochnyh Iasykof Aziatskavo Departamenta Ministerstva Inostrannyh Diel (*Institute of Oriental Languages in the Asiatic Department of the Foreign Office*). [i]

7485. Uchonyi Komitet Ministerstva Gosudarstvennyh Imushchestv (*Scientific Committee of the Ministry of State Domains*). [i]

7487. Voienno-meditsinskii Zhurnal (*Military Medical Journal*). [i]

7489. Voiennoie Ministerstvo (*Ministry of War*).

7491. Zemledielcheskii Institut (*Agronomical Institute*). [i]

7493. Zemledielcheskii Musei Ministerstva Gosudarstvennyh Imushchestv (*Agricultural Museum of the Ministry of State Domains*). [i]

Tashkent (*in Turkestan*).

7495. Magnitnaia i Meteorologicheskaia Observatoria (*Magnetic and Meteorological Observatory*). [i]

Tiflis.

7497. Imper. Kavkazskoie Meditsinskoie Obshchestvo (*Imperial Caucasian Medical Society*). [i]

7499. Kavkazskii Muzei (*Caucasian Museum*). [i]

7501. Kavkazskii Otdiel Imper. Russkavo Geograficheskavo Obshchestva (*Caucasian Section of the Imperial Russian Geographical Society*). [i]

7503. Kavkazskoie Obshchestvo Selskovo Hoziaistva (*Caucasian Society of Rural Economy*). [i]

7505. Magnitnaia i Meteorologicheskaia Observatoria (*Magnetic and Meteorological Observatory*) [Physikalisches Observatorium]. [i]

7507. Publichnaia Biblioteka (*Public Library*). [i]

[Tifliser Physikalisches Observatorium (*Physical Observatory of Tiflis*). (See Magnitnaia i Meteorologicheskaia Observatoria.)]

7509. Upravlenie Gornoiu Chastiu na Kavkazie i za Kavkazom (*Administration of Caucasian and Trans-caucasian Mines*).

Tula.

7511. Publichnaia Biblioteka (*Public Library*). [i]

7513. Statisticheskii Komitet (*Statistical Committee*). [i]

Uman (*District of Kief*).

7515. Umanskoie Uchilishche Zemledielia i Sadovodstva (*Agricultural and Horticultural School of Uman*). [i]

Varshava (*Warsaw*).

7517. Astronomicheskaia Observatoria (*Astronomical Observatory*). [i]

7519. Gazeta Lékarska (*Medical Journal*). [i]

7521. Imper. Varshafskii Universitet (*Imperial University of Warsaw*). [i]

7523. Mediko-Hirurgicheskaia Akademia (*Medico-Surgical Academy*). [i]

7525. Obshchestvo Pooshchrenia Hudozhestv v Tsarstvie Polskom (*Society for the Encouragement of Fine Arts in the Kingdom of Poland*). [i]

7527. Towarzystwo Rolnicze Królestwa Polskiego (*Agricultural Society of the Kingdom of Poland*).

Vilna.

7529. Imper. Vilenskoie Meditsinskoie Obshchestvo (*Imperial Medical Society of Vilna*). [i]

[Musei Drevnostei (*Museum of Antiquities*). (See Vilenskaia Publichnaia Biblioteka, &c.)]

7531. Sieverozapadnyi Otdiel Imper. Russkavo Geograficheskavo Obshchestva (*Northwestern Section of the Imperial Russian Geographical Society*). [i]

Vilna—Continued.

7533. Vilenskaia Arkeograficheskaia Kommissia (*Archæographical Commission of Vilna*). [i]

7535. Vilenskaia Astronomicheskaia Observatoria (*Astronomical Observatory of Vilna*). [i]

7537. Vilenskaia Publichnaia Biblioteka i Musei Drevnostei (*Vilna Public Library and Museum of Antiquities*). [i]

Vladimir.

7539. Imperial School of Marine Jurisprudence. [i]

SERVIA.

Belgrade.

7541. Drushtvo srbske Slovessnosti (*Society of Servian Literature*). [i]

7543. Praviteljstvena Biblioteka (*State Library*). [i]

SPAIN.

Barcelona.

7544. Academia de Ciencias, Artes, y Oficios para la Mujer (*Academy of Sciences, Arts, and Female Industries*).

7545. "Crónica Científica" (*"Scientific Chronicle"*). [i]

7547. Instituto Agricola Catalan de San Isidro (*Catalanian Agricultural Institute of San Isidro*). [i]

7549. Observatorio Meteorológico (*Meteorological Observatory*).

7551. Real Académia de Buenas Letras de Barcelona (*Royal Academy of Belles-Lettres, of Barcelona*). [i]

Bilbao.

7553. Board of Charity—Library of Charitable Instruction.

7555. Observatorio Meteorológico (*Meteorological Observatory*).

Burgos.

7557. Observatorio Meteorológico (*Meteorological Observatory*).

Cadiz.

7559. Sociedad Económica Gaditana de Amigos del País (*Gaditana Economical Society*). [i]

7561. Sociedad Protectora de los Animales y las Plantas (*Society for the Protection of Animals and Plants*). [i]

Cordova.

7563. Academia Nacional de Ciencias Exactas (*National Academy of Exact Sciences*). [i]

Granada.

7565. Universidad de Granada (*University of Granada*). [i]

Madrid.

7567. Academia de las tres Nobles Artes de San Fernando (*San Fernando Academy of the Three Noble Arts*). [i]

Madrid—Continued.

7569. Academia Especial de Ingenieros (*Special Academy for Engineers*). [i]
7571. Ateneo Científico, Literario y Artístico (*Scientific Literary and Artistic Atheneum*).
7573. Biblioteca Nacional (*National Library*). [iii]
[Colonial Department. (See Ministerio de las Colonias).]
7575. Comision del Mapa Geológico de España (*Commission for the Geological Map of Spain*).
7577. "Correspondencia de España" (*Spanish Correspondence*).
7579. Direccion del "Memorial de Artillería" (*Artillery Notes*).
7581. Escuela de Ingenieros de Caminos, Canales, y Puertos (*School of Civil Engineering*).
7583. Instituto Geográfico y Estadístico (*Geographical and Statistical Institute*). [i]
7585. Junta Estadística (*Statistical Society*). [i]
7587. "La España Agricola": Asociacion General de Labradores (*The Spanish Farmer, General Association of Workmen*). [i]
7589. Ministerio de Fomento—Direccion General de Instruccion Pública (*Department of the Interior—General Office of Public Instruction*).
7591. Ministerio de las Colonias (*Colonial Department*). [i]
7593. Museo Arqueológico Nacional (*National Archæological Museum*). [i]
7595. Observatorio de Madrid (*Madrid Observatory*). [i]
7597. Real Academia de Ciencias de Madrid (*Royal Academy of Sciences, of Madrid*). [iii]
7599. Real Academia de Ciencias Morales y Políticas (*Royal Academy of Moral and Political Sciences*). [iii]
7601. Real Academia Española Arqueológica y Geográfica (*Royal Spanish Academy of Archæology and Geography*). [i]
7603. Real Academia de la Historia (*Royal Academy of History*). [iii]
7605. Revista de la Arquitectura (*Review of Architecture*). [i]
7607. Revista Minera y Metallúrgica (*Mineral and Metallurgical Review*).
7609. Sociedad de Antropológia de Madrid (*Anthropological Society*). [i]
7611. Sociedad Central de Arquitectos (*Central Society of Architects*). [i]
7613. Sociedad Española de Historia Natural (*Spanish Society of Natural History*). [i]
7615. Sociedad Geográfica de Madrid (*Geographical Society*). [i]
[Sociedad de Professores de Ciencias (*Association of Professors of Science*).]
7617. Universidad de Madrid (*University of Madrid*). [i]

Murcia.

7619. Observatorio Meteorológico (*Meteorological Observatory*).

Oviedo.

7621. Instituto Provincial de Oviedo (*Provincial Institute*).

San Fernando.

7623. Instituto y Observatorio de Marina (*Naval Institute and Observatory*). [i]

7625. Real Academia de Bellas Artes de San Fernando (*Royal Academy of Fine Arts*). [i]

Santiago.

7627. Observatorio Meteorológico (*Meteorological Observatory*).

Valencia.

7629. Real Sociedad Económica (*Royal Economic Society*). [i]

Viscaya (*Biscay*).

7631. Instituto Provincial de Viscaya (*Provincial Institute of Biscay*).

SWEDEN.

Fahlen.

[Bergschule. (Dissolved. Now Mining School, Stockholm.)]

Götheborg.

7633. Kongliga Vetenskaps och Vitterhets Samhället (*Royal Society of Sciences and Belles-Lettres*). [iii]

[Sälleskapet Småfoglarnas Vänner (*Society for the Protection of Small Birds*). (Discontinued.)]

Linköping.

7635. Ostgota Fornminnes Forening (*East Gothland Antiquarian Society*).

Lund.

7637. Ethnologiska Museum (*Ethnological Museum*).

7639. Kongliga Fysiografiska Sällskapet (*Royal Physiographic Society*). [i]

7641. Kongliga Universitetet (*Royal University*). [iii]

[Nordisk Tidsskrift för Politik Ekonomie, och Litterature (Discontinued.)]

7643. Universitets Observatoriet (*University Observatory*). [i]

Stockholm.

7644. Departementet för Fiskeri. [Is a department of the Kongliga Landtbrucks Akademien. (Packages addressed to care of Fischerei-intendant, Dr. R. Lundberg.)] [i]

7645. Entomologiske Forening (*Entomological Society*). [i]

7647. Entomologiske Tidsskrift (*Entomological Journal*).

Stockholm—Continued.

7649. "Eira" (*Medical Journal*).

[Geographical Society. (See Svenska Sällskapet för Antropologie och Geografie.)]

7651. Geologiska Byrån (*Geological Bureau*). [i]

7653. Geologiska Foreningen (*Geological Society*).

[Geological Survey. (See Geologiska Byrån.)]

7655. Jernkontoret (*Offices of Forges*). [i]

7657. Kongliga Bibliotheket (*Royal Library*). [iii]

7659. Kongliga Landtbrucks Akademien (*Royal Academy of Agriculture*). [i]

7661. Kongliga Svenska Vetenskaps Akademien (*Royal Swedish Academy of Sciences*). [iii]

7663. Kongliga Vitterhets Historie och Antiquitets Akademien (*Royal Academy of Belles-Lettres, History, and Antiquities*). [iii]

["Land och Folk." (Discontinued.)]

7665. Meteorologiska Central Anstalten (*Central Meteorological Institute*). [i]

7667. Mining School [address at Technic High School]. [i]

7669. Minister of Foreign Affairs.

7671. Nordisk Mediciniske Arkiv (*Northern Medical Archives*).

7673. Observatoriet (*Observatory*). [i]

7675. Statistiska Central Byrån (*Bureau of Statistics*). [i]

7677. Svenska Akademien (*Swedish Academy*). [i]

7679. Svenska Läkare Sällskapet (*Swedish Society of Physicians*). [i]

7681. Svenska Bokförlaggare Forening (*Society of Editors*). [Care of Samson & Wallin, Stockholm.]

7683. Svenska Sällskapet för Antropologi och Geografie (*Society of Anthropology and Geography*).

Upsala.

7685. Kongliga Universitetet (*Royal University*). [i]

7687. Kongliga Vetenskaps Societäten (*Royal Society of Sciences*). [iii]

7689. Prof. P. J. Lindell (*Royal University*). [i]

7691. Svenska Fornminnes Forening (*Swedish Antiquarian Society*). [i]

7693. Universitets Astronomiska Observatoriet (*University Astronomical Observatory*).

7694. Universitets Meteorologiska Observatoriet (*University Meteorological Observatory*). [i]

Vesterås.

[Elementar Läroverkets Biblioteket (*Library of the Normal School*). [Dissolved.)]

Vesterås—Continued.

7695. Läkare Sällskapet (*Physicians' Society*).
7697. Riksbibliotheket (*State Library*).

SWITZERLAND.

7699. Schweizerischer Forst-Verein (*Swiss Foresters' Union*). [i]
7701. Schweizerische Paläontologische Gesellschaft (*Swiss Palæontological Society*). [i]
7703. Schweizerischer Verein für Straf- und Gefängnisswesen (*Swiss Association for the Management of Prisons*). [i]

Aarau.

7705. Aargauische Naturforschende Gesellchaft (*Society of Naturalists*). [i]
[Blinden und Taubstummen Institut. (See Laudenhof.)]

Basel.

7707. Gesellschaft zur Beförderung des Guten und Gemeinnützigen (*Society for the Promotion of Morality and Public Welfare*). [i]
7709. Gewerbe-Schule (*Polytechnical School*). [i]
7711. Historische und Antiquarische Gesellschaft (*Historical and Antiquarian Society*). [iii]
7713. Kinder-Spital (*Hospital for Children*).
7715. Naturforschende Gesellschaft (*Naturalists' Society*). [iii]
7717. Universitäts-Bibliothek (*University Library*). [i]
7719. Verein Schweizerischer Gymnasiallehrer (*Society of Swiss Teachers*).

Bern.

7721. Allgemeine Schweizerische Gesellschaft für die Gesammten Naturwissenschaften (*Swiss Society of Natural Sciences in General*). [i]
7723. Bibliothèque Fédérale (*Federal Library*). [i]
7725. Bureau Topographique Fédéral [État Major] (*Topographical Bureau*).
7727. Commission de la Carte Géologique de la Suisse (*Commission for the Geological Chart of Switzerland*). [Care of Bibliothèque du Polytechnique à Zurich.]
7729. Eidgenossensche Bundes-Kanzlei (*Helvetic Federal Chancelry*). [i]
7731. Eidgenossensches Departement des Innern (*Helvetic Interior Department*). [i]
[Eidgenossenscher Inspector der Gotthard Eisenbahn (*Inspector of the Gotthard Railroad*). (See No. 7737.)]
7733. Eidgenossensches Statistisches Bureau (*Statistical Bureau*). [i]
7735. Geographische Gesellschaft (*Geographical Society*). [i]
7737. Inspectorat technique des Chemins de Fer Suisses (*Office of Inspector of the Swiss Railroads*). [i]

Bern—Continued.

7739. Institut Géographique International (*International Geographical Institute*). [i]
7741. Illustrirte Vierteljahrschrift für ärztliche Polytechnik (*Illustrated Quarterly Journal of Medical Polytechnic*). [i]
7743. Kantons Schule (*Cantonal School*). [i]
7745. Naturforschende Gesellschaft (*Naturalists' Society*). [iii]
7747. Oekonomische Gesellschaft des Kanton Bern (*Economical Society of the Canton of Bern*). [i]
7749. Schweizerischer Alpen Club (*Swiss Alpine Club*). [i]
7751. Schweizerische Entomologische Gesellschaft (*Swiss Entomological Society*). [i]
7753. Schweizerische Gemeinnützige Gesellschaft (*Swiss Society for Public Welfare*). [i]
7755. Schweizerische Historische Gesellschaft (*Swiss Historical Society*). [i]
7757. Schweizerischer Lehrer-Verein (*Swiss Pedagogic Society*). [i]
7759. Société des Sciences (*Society of Sciences*). [i]
7761. Société des Sciences Naturelles (*Society of Natural Sciences*). [iii]
7763. Sternwarte (*Observatory*). [i]
7765. Tellurisches Observatorium (*Tellurian Observatory*).
7767. Universitäts-Bibliothek (*University Library*). [iii]

Chur.

7769. Naturforschende Gesellschaft Graubündens (*Society of Natural Sciences of Graubünden*). [i]

Frauenfeld.

7771. Thurgauische Naturforschende Gesellschaft (*Thurgau Naturalists' Society*). [i]

Fribourg.

7773. Société Fribourgeoise des Naturalistes (*Fribourg Society of Naturalists*). [i]
7775. Société d'Histoire du Canton de Fribourg (*Historical Society of the Canton of Fribourg*). [i]

Genève.

7777. Archives des Sciences Physiques et Naturelles (*Archives of Physical and Natural Sciences*). [i]
7779. Association Zoologique du Léman (*Zoological Society of Lake Leman*). [i]
7781. Bibliothèque de la Ville (*City Library*). [iii]
7783. "Bibliothèque Universelle." [i]
7785. Institut National Génevois (*National Institute of Geneva*). [i]

Genève—Continued.

7787. "Le Globe" [Organe de la Société de Géographie de Genève] (*The World*).
7789. Musée de la ville de Genève (*City Museum*). [i]
7791. Musée Zoologique (*Zoological Museum*). [i]
7793. Observatoire (*Observatory*). [i]
7795. Société des Arts de Genève (*Geneva Society of Arts*). [i]
7797. Société Génevoise d'Utilité Publique (*Geneva Society for the Public Welfare*). [i]
7799. Société d'Histoire et d'Archéologie de Genève (*Geneva Society of History and Archæology*). [i]
7801. Société de Géographie (*Geographical Society*). [i]
7803. Société de Lecture (*Lecture Society*). [i]
7805 Société de Physique et d'Histoire Naturelle (*Society of Physics and Natural History*). [iii]
7807. Société Médicale (*Medical Society*). [i]
7809. Société Ornithologique Suisse (*Swiss Ornithological Society*). [i]
7811. Société Suisse de Topographie (*Swiss Topographical Society*). [i]

Laudenhof (*bei Aarau*).

7813. Taubstummen - Anstalt (*Institution for the Deaf and Dumb*). [i]

Lausanne.

7815. Asile des Aveugles de Lausanne (*Asylum for the Blind*). [i]
7817. Bibliothèque Cantonale Vaudoise (*Library of the Canton of Vaud*). [i]
7819. Société d'Agriculture de la Suisse Romande (*Agricultural Society*). [i]
7821. Société d'Histoire de la Suisse Romande (*Historical Society*). [i]
[Société Industrielle d'Horlogerie. (Dissolved.)]
7823. Société Vaudoise des Sciences Naturelles (*Society of Natural Sciences*). [i]

Luzern.

7824. Direction der Gothard Eisenbahn (*Office of the Directors of the Gothard Railroad*).
7825. Historischer Verein der Fünf - Oerter (*Historical Society*). [i]
7827. Kantons-Schule (*Cantonal School*). [i]

Neufchâtel.

7829. Le Conseil Municipal (*City Council*).
7831. Observatoire Cantonal (*Cantonal Observatory*). [i]
7833. Société des Sciences Naturelles (*Society of Natural Sciences*). [iii]

Olten.

7835. Naturforschende Gesellschaft Graubündens (*Naturalists' Society*).

Porentruy.

7837. Société Jurassienne d'Émulation (*Jurassian Society of Emulation*). [i]

Rapperschwyl.

7839. Musée National Polonais (*Historical Museum of Poland*). [i]

Rheinfelden.

7841. Naturhistorische Gesellschaft (*Natural History Society*). [i]

Saint Gall.

[Concordia Institut International et École Supérieure de Commerce (*Concordia International Insiitute and Commercial College*). (See Zurich.)]

7843. Naturwissenschaftliche Gesellschaft (*Society of Natural Sciences*). [i]

Schaffhausen.

7845. Mittheilungen der Schweizer Entomologischen Gesellschaft (*Journal of the Swiss Entomological Society*).

7847. Société des Sciences Naturelles (*Society of Natural Sciences*). [i]

Sion.

7849. Société Murithienne du Valais (*Murithian Society of the Valais*). [i]

7851. Société Valaisanne des Sciences Naturelles (*Society of Natural Sciences of the Valais*). [i]

Solothurn.

7853. Naturforschende Gesellschaft (*Society of Naturalists*). [i]

Yverdon.

7855. Institut des Sourds-Muets à Yverdon (*Institute for the Deaf and Dumb*). [i]

Zurich.

7857. Antiquarische Gesellschaft (*Antiquarian Society*). [iii]
7859. Concordia Institute [formerly in Saint Gall]. [i]
7861. Count Ladislas Plater (Villa Broelberg). [i]
7863. Eidgenossensche Polytechnische Schule (*Federal Polytechnic School*). [iii]
7865. Karten-Verein (*Chart Association*). [i]
7867. Naturforschende Gesellschaft (*Society of Naturalists*). [iii]
7869. Schweizerischer Apotheker-Verein (*Swiss Apothecaries' Society*). [i]
7871. Schweizerische Meteorologische Central-Anstalt (*Swiss Central Meteorological Bureau*). [i]
7873. Société de Médecine (*Medical Society*). [i]

Zurich—Continued.

7875. Société des Sciences Physiques et Naturelles (*Society of Physical and Natural Sciences*). [i]
7877. Sternwarte (*Observatory*). [Transfer books to the Federal Polytechnical School.]
7879. Universitäts- und Kantons-Bibliothek (*University and Cantonal Library*). [iii]
7881. Verein für Landwirthschaft und Gartenbau (*Agricultural and Horticultural Society*). [i]
7883. Vierteljahrsschrift für Wissenschaftliche Philosophie (*Quarterly Journal of Scientific Philosophy*).
7885. Zoologisches Museum (*Zoological Museum*). [i]

SYRIA.

Beirut.

7887. Syrian Protestant College.
7889. Lee Observatory.

TURKEY.

Constantinople.

7891. His Imperial Majesty the Sultan. [iii]
7893. Administration Sanitaire de l'Empire Ottoman (*Board of Health*). [i]
[American Missionary Society. (See No. 7911.)]
[American College. (See Robert College.)]
7897. Anjuman i Danish (*Society for the Advancement of Turkish Literature*). [i]
7899. Bureau de Statistique (*Statistical Bureau*). [i]
7901. Gazette Médicale de l'Orient (*Medical Gazette of the Orient*). [i]
7903. Hellenic Literary Syllogog (Library). [i]
7905. Hellenic Philological Society of Constantinople. [i]
7907. Imperial Meteorological Observatory. [i]
7909. Jemiyet Ilamiyet Osmoniyet (*Ottoman Scientific Society*). [i]
7911. Library of the American Missionary Society. [i]
7913. Robert College. [iii]
7915. Société Impériale de Médecine (*Imperial Society of Medicine*). [i]
7917. Société Orientale de Constantinople (*Oriental Society of Constantinople*). [i]
7919. Société de Pharmacie de Constantinople (*Pharmaceutical Society of Constantinople*). [i]

Sophia (*Bulgaria*).

7921. National Library. [i]

MISCELLANEOUS.

7923. Association Internationale du Congo [Berlin, 1884] (*International Congo Conference*).
7925. Congress International des Américanistes [Tours, France, 1883] (*International Congress of Americanists*).
7927. Congrès International des Botanistes, d'Horticulteurs, de Négociaults et des Fabricants de Produits du Règne Végétale [Leiden, 1879] (*International Congress of Botanists, Horticulturists, Dealers and Manufacturers of Vegetable Products*).
7929. Congrès International des Sciences Géographiques (*International Congress of Geographical Sciences*).
7931. Congrès International des Sciences Géologiques [Berlin, 1884–'85, London, 1888] (*International Congress of Geological Sciences*).
7933. Congrès International de la Propriété Artistique [Paris, 1878] (*International Artistic Congress*).
7935. Congreso Internacional de Americanistas [Madrid, 1881] (*International Congress of Americanists*).
7937. International Agricultural and Forestry Congress.
7939. International Benevolent Congress.
7941. International Botanical and Horticultural Congress.
7943. International Committee of Weights and Measures.
7945. International Congress of Commercial Geography.
7947. International Congress of Orientalists.
7949. International Congress of Prehistoric Anthropology and Archæology.
7951. International Geodesic Association.
7953. International Meteorological Committee [London].
7955. International Meteorological Congress.
7957. International Meter Commission.
7959. International Polar Conference.
7961. International Pomological Congress.
7963. International Sanitary Conference.
7965. International Silk-Culturists' Congress.
7967. International Statistical Congress.
7969. International Telegraphic Convention.

LIST OF INSTITUTIONS IN THE UNITED STATES TO WHICH SMITHSONIAN PUBLICATIONS ARE SENT. (1885).

[The figure [i] indicates *Smithsonian Reports;* [ii] indicates *Reports* and *Miscellaneous Collections;* [iii] indicates *Reports, Miscellaneous Collections,* and *Smithsonian Contributions to Knowledge.*]

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5. Value of buildings and property, ———.
6. Permanent fund, ———.
7. Annual income, ———.
8. Number of volumes in library, ———.
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ALABAMA.

Auburn.

Agricultural and Mechanical College. [ii]

Greensborough.

Southern University. [iii]

Huntsville.

State Normal School (Colored). [i]

James.

High School. [i]

Marion.

Howard College. [iii]

Lincoln Normal University. [i]

Mobile.

Library Association. [i]

Montgomery.

State Board of Health. [i]

Spring Hill.

Spring Hill College. [ii]

Talladega.

Alabama Institution for the Deaf, Dumb, and Blind. [i]

Tuscaloosa.

Alabama Insane Hospital. [i]

Geological Survey of Alabama. [i]

University of Alabama. [iii]

Tuskegee.

Alabama Conference Female College. [i]

Alabama High School. [i]

Normal School. [i]

ARKANSAS.

Boonsborough.

Cane Hill College. [i]

Fayetteville.

Arkansas Industrial University. [ii]

Little Rock.

Arkansas School for the Blind. [i]

Arkansas State Library. [iii]

Little Rock Public Library (formerly Mercantile Library). [i]

Little Rock University. [i]

CALIFORNIA.

Alameda.

Alameda Free Library. [i]

Berkeley.

Institution for the Deaf, Dumb, and Blind. [i]

University of California. [iii]

Carpenteria.

Carpenteria Science Club. [i]

College City.

- Pierce Christian College. [i]

Marysville.

- Marysville City Library. [iii]

Middletown.

- Industrial Training School. [i]
- Mills Seminary, Mills College. [i]

Monterey.

- Monterey Library Association. [iii]

Oakland.

- Ebell Society Library. [i]
- Free Public Library. [i]

Pasadena.

- Pasadena Free Library. [i]

Sacramento.

- Agassiz Institute. [i]
- California State Agricultural Society. [i]
- California State Library. [iii]
- Sacramento Free Library. [iii]
- Sacramento Institute. [i]
- State Engineer's Office. [i]

San Diego.

- San Diego Lyceum of Sciences. [i]
- San Diego Public Library. [i]
- San Diego Society of Natural History. [i]

San Francisco.

- Bancroft Library (Pacific Library). [iii]
- Bibliothèque de la Ligue Nationale Française. [iii]
- Bohemian Club. [i]
- California Academy of Sciences. [iii]
- California State Geological Society (see California State Mining Bureau).
- California State Horticultural Society. [i]
- California State Mining Bureau. [i]
- Central Pacific Railroad Law Library. [i]
- Geographical Society of the Pacific. [i]
- Lick Observatory. [i]
- Mechanics' Institute. [iii]
- Mercantile Library Association. [iii]
- Odd Fellows' Library Association. [iii]
- Pacific Library (see Bancroft Library).
- Saint Ignatius College. [ii]
- San Francisco Free Public Library. [iii]
- San Francisco Law Library. [i]
- State Board of Horticulture. [i]
- West's (Miss) School for Girls. [i]

San José.

- California State Normal School. [i]
- San José Free Public Library. [i]
- University of the Pacific. [ii]

San Mateo.

- Laurel Hall Seminary. [i]

Santa Barbara.

- Morris House Library. [i]
- Santa Barbara Free Public Library. [ii]
- Santa Barbara Society of Natural History. [i]
- Union Club of Santa Barbara. [i]

Santa Clara.

- Santa Clara College. [iii]

Stockton.

- County Board of Horticultural Commissioners. [i]
- San Joaquin Society of California Pioneers. [i]

COLORADO.

Boulder.

- University of Colorado. [i]

Cañon City.

- Grand Army Collegiate and Military Institute. [i]

Colorado Springs.

- Colorado College. [i]

Denver.

- Bishop's Library. [i]
- Colorado Scientific Society. [i]
- Colorado Seminary (see University of Denver).
- Jarvis Hall School for Boys, and Divinity School. [i]
- State Library. [iii]
- United States Geological Survey, Division of the Rocky Mountains. [i]
- University of Denver. [ii]
- Wolf Hall School for Girls. [i]

Fort Collins.

- Colorado Agricultural College. [i]

Golden.

- State School of Mines. [i]

Red Cliff.

- Eagle County Mining Club. [i]

CONNECTICUT.

Birmingham.

- Allis Circulating Library. [i]

Bridgeport.

- Bridgeport Public Library and Reading Room. [iii]
- Bridgeport Scientific Society. [i]

Columbia.

Columbia Free Library. [i]

Goshen.

Goshen Academy. [i]

Greenwich.

Greenwich Free Reading Room and Library Association. [i]

Hartford.

Connecticut Historical Society. [iii]
Connecticut Retreat for the Insane. [i]
Connecticut State Board of Agriculture. [i]
Hartford Library (formerly Young Men's Institute). [i]
Hartford Theological Seminary. [iii]
State Board of Education. [i]
State Library of Connecticut. [iii]
Trinity College. [iii]
Watkinson Library of Reference. [i]
Young Men's Institute (see Hartford Library).

Mansfield.

Storr's Agricultural School. [i]

Meriden.

Meriden Scientific Association. [i]

Middletown.

Central School. [i]
Wesleyan University. [iii]

New Britain.

New Britain Scientific Association. [i]
Public High School. [i]
State Normal School. [iii]

New Haven.

American Oriental Society. [iii]
Connecticut Academy of Arts and Sciences (see Yale College).
Hillhouse High School. [i]
New Haven Colony Historical Society. [i]
New Haven Young Men's Institute. [iii]
Peabody Museum (see Yale College).
Sheffield Scientific School (see Yale College).
State Board of Health. [i]
Yale College. [iii]
  Connecticut Academy of Arts and Sciences. [i]
  Peabody Museum. [i]
  Sheffield Scientific School. [ii]

New London.

New London County Historical Society. [i]

Norwich.

Otis Library. [ii]

Shaker Station.

Shaker Community for Religious and Charitable Objects. [i]

Simsbury.
Simsbury Free Library. [i]
Suffield.
Connecticut Literary Institution. [i]
Waterbury.
Silas Bronson Library. [iii]
Woodstock.
Woodstock Academy. [i]

DAKOTA.

Brookings.
Dakota Agricultural College. [i]
Ellendale.
Ellendale Library Association. [i]
Lisbon.
Lisbon Library Association. [i]
Pierre.
Presbyterian University of Southern Dakota. [i]
Roscoe.
Roscoe Reading Room. [i]
Vermillion.
University of Dakota. [i]
Webster.
Day County Agricultural Society. [i]
Yankton.
Yankton College. [i]

DELAWARE.

Dover.
Delaware State Library. [iii]
Newark.
Delaware State College.. [iii]
New Castle.
New Castle Library Company (Public Library). [iii]
Wilmington.
West End Library (Lincoln street, above Delaware avenue). [i]
Western Free Library (Women's Christian Temperance Union), Third and Washington streets. [i]
Wilmington Institute. [iii]

DISTRICT OF COLUMBIA.

Washington.
Agricultural Department, Library of. [iii]
Entomological Division. [i]
Botanic Garden, Library of. [i]
Bureau of Ethnology (see Smithsonian Institution).
Civil Service Commission, Library of. [i]

Washington—Continued.

- Congress, Library of. [iii]
- Department of Justice, Library of. [i]
- Executive Mansion, Library of. [i]
- Fish Commission, Library of. [i]
- House of Representatives, Library of. [i]
- Interior Department:
  - Assistant Attorney-General. [i]
  - Bureau of Education. [ii]
  - Library of the Interior Department. [iii]
  - Scientific Library of Patent Office. [iii]
  - United States Geological Survey. [iii]
- National Museum (see Smithsonian Institution).
- Navy Department:
  - Bureau of Navigation. [i]
  - Hydrographic Office. [i]
  - Museum of Hygiene (Bureau of Medicine and Surgery). [i]
  - Nautical Almanac Office. [i]
  - Naval Observatory. [iii]
  - Navy Department Library. [iii]
  - Surgeon-General, U. S. Navy. [i]
- Patent Office (see Interior Department).
- Post-Office Department Library. [i]
- Smithsonian Institution: [iii]
  - Bureau of Ethnology. [iii]
  - United States National Museum. [iii]
- State Department Library. [iii]
  - Consular Bureau. [i]
- Treasury Department:
  - Bureau of Engraving and Printing. [i]
  - Bureau of Statistics. [i]
  - Director of the Mint. [i]
  - Life-Saving Service. [i]
  - Light-House Board. [i]
  - Marine Hospital Service, Surgeon-General. [i]
  - Solicitor of the Treasury, Office of. [i]
  - Treasury Department Library. [ii]
  - United States Coast and Geodetic Survey. [i]
- United States Supreme Court, Library of. [i]
- War Department:
  - Army Medical Museum (see Surgeon-General's Office).
  - Bureau of Military Justice. [i]
  - Chief of Engineers, Office of (see Engineer Department, U. S. A.).
  - Chief Signal Officer, Office of (see Signal Office.)
  - Engineer Department, U. S. A. (Office Chief of Engineers). [iii]

Washington—Continued.

- Headquarters of the Army of the United States. [i]
- Ordnance Department, Office of Chief of Ordnance. [i]
- Quartermaster-General's Office. [ii]
- Signal Office Library. [ii]
- Subsistence Department, Commissary-General. [i]
- Surgeon-General's Office, Library of. [iii]
- War Department Library. [iii]

Miscellaneous:

- Academy of the Visitation. [i]
- Agassiz Association. Chap. 109. (No. 1600, 13th st). [i]
- Carroll Literary Institute. [i]
- Columbia Hospital for Women. [i]
- Columbia Institution for the Deaf and Dumb (National Deaf Mute College). [iii]
- Columbian Club. [i]
- Columbian University. [iii]
- Corcoran Gallery of Art. [i]
- Cosmos Club. [i]
- District of Columbia Library (Office of the Commissioners of the District of Columbia). [i]
- Georgetown University. [iii]
- Government Hospital for the Insane. [i]
- Health Department (Office of Health Officer). [i]
- Howard University. [ii]
- Kit Carson Post, G. A. R. [i]
- Louise Home. [i]
- Masonic Library. [i]
- Medical Society of District of Columbia. [i]
- National Board of Health. [i]
- National College of Pharmacy. [i]
- National Deaf Mute College (see Columbia Institution for the Deaf and Dumb).
- Norwood Institute. [i]
- Odd Fellows' Library. [i]
- Sailor's Library, Navy Yard. [i]
- Saint John's Collegiate Institute (formerly Saint Matthews' Institute). [i]
- Soldiers' Home Library. [i]
- Spencerian Business College. [i]
- Washington High School. [iii]
- Washington Light Infantry Corps. [i]
- Washington Microscopical Society. [i]
- Young Men's Christian Association. [i]
- Young People's Union of the Memorial Lutheran Church. [i]

FLORIDA.

De Funiak Springs (Lake de Funiak).
- Florida Chautauqua Library. [i]

Jacksonville.
- Public Library. [i]

Milton.
- Santa Rosa Academy Public Library. [ii]

Pensacola.
- Young Men's Christian Association. [i]

Saint Augustine.
- Free Public Library, [i]
- Military Post, U. S. A, Library of. [i]
- Saint Augustine Institute of Natural Science. [i]

Sanford.
- Sanford Library and Reading Room. [i]

Tallahassee.
- Florida University. [i]

GEORGIA.

Athens.
- Home School for Young Ladies. [i]
- University of Georgia. [iii]

Atlanta.
- Abyssinian Library Society. [i]
- Atlanta Medical College. [i]
- Department of Agriculture. [ii]
- Department of Education. [i]
- Georgia Eclectic Medical College. [i]
- State Library. [iii]
- Young Mens' Library Association. [ii]

Augusta.
- Medical Department of University of Georgia. [i]
- Young Men's Library Association. [i]

Barnesville.
- Gordon Institute Library. [i]

Blackshear.
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Bowdon.
- Bowdon College. [i]

Brunswick.
- Brunswick Library Association. [i]

Butler.
- Butler Female College and Male Institute. [i]

Carrollton.

Reese's High School. [i]

Cave Spring.

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Columbus.

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Dahlonega.

North Georgia Agricultural College. [i]

Forsyth.

Monroe Female College. [i]

Hinesville.

Bradwell Institute (see Walthoursville).

Macon.

Georgia State Agricultural Society. [i]
Mercer University. [iii]
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Wesleyan Female College. [i]

Milledgeville.

Georgia State Lunatic Asylum. [i]

Monroe.

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Emory College. [iii]

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Roscoe.

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Abingdon.
- Hedding College. [i]

Albion.
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Aledo.
- Mercer County Scientific Association. [i]

Aurora.
- Young Men's Christian Association. [i]

Barry.
- Library and Reading Room. [i]

Belvidere.
- Ida Public Library. [i]

Bethany.
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Bloomington.
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- Saint Viateur's College. [i]

Bushnell.
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- Byron Library. [i]

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Carbondale.
- Southern Illinois Normal University. [ii]

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- Carrollton Library Association. [i]

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- University of Illinois (formerly Illinois Industrial University). [iii]

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- Chicago Academy of Sciences. [iii]

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Chicago Athenæum. [i]
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Dixon.

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Dover.

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Elmhurst.

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- Warren County Library and Reading Room Association. [iii]

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- Illinois State Laboratory of Natural History. [iii]
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Bourbon.
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Fort Wayne Public School Library. [i]

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Greencastle.

De Pauw University (formerly Asbury University). [iii]
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Greenfield.

Greenfield Society for the Advancement of Science. [i]

Greenwood.

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Hanover.

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Hartsville.

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Indianapolis.

Bureau of Statistics of Indiana. [i]
Department of Geology and Natural History. [i]
Indiana Hospital for the Insane. [i]
Indiana Institution for the Education of the Blind. [i]
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La Porte.

Public Library and Natural History Society. [ii]

Laurel.
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Lawrenceburg.
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Borden Institute Historical Society. [i]

Notre Dame.
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Paoli.
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Spiceland.
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Rose Polytechnic Institute. [iii]

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Winchester.
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Tahlequah.
Cherokee National Female Seminary. [i]
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Albion.
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Ames.
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Bloomfield.
Academy of Science. [i]
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Public Library. [i]

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Grand Lodge of Masons of Iowa. [ii]

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- Amity College. [i]

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- Free Public Library. [i]
- Iowa Institution for the Deaf and Dumb. [i]

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- Griswold College. [iii]

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- Drake University. [i]
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Dexter.
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Earlham.
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- Jefferson County Library Association. [ii]
- Parsons College. [i]

Fayette.
- Upper Iowa University. [i]

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- Indianola Public Library. [i]
- Simpson Centenary College. [ii]

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- Iowa Weather Service. [i]
- State Historical Society of Iowa. [iii]
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Philomathean Society. [i]

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Cornell College. [iii]

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Osage.

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Ottumwa.

Wapello County Natural Science Association. [i]

River View.

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Shenandoah.

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Sutherland.

General (N. B.) Baker Library. [i]

Tabor.

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West Union.

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Atchison.

Kansas Baptist Association. [i]

Saint Benedict's College. [i]

Baldwin City.

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Black Jack.
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Burlington.
Otter Creek Library Association. [i]

Emporia.
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Medical Director's Office of the Department of Missouri. [i]

Girard.
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Holton.
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Lawrence.
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Leavenworth.
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Manhattan.
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Norton.
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Olathe.
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Ottawa.
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Frankfort.

Bureau of Agriculture, Horticulture, and Statistics. [i]
Department of Public Instruction. [i]
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Salem College. [i]

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- Southern Baptist Theological Seminary (formerly at Greenville, S. C.). [ii]

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- Maysville and Mason County Library, Historical and Scientific Association. [i]

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- Seminary and Normal School. [i]

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- Louisiana State University and Agricultural and Mechanical College. [iii]

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- Insane Asylum of the State of Louisiana. [i]

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- Board of Health. [i]
- City Library. [iii]
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- New Orleans Produce Exchange. [i]
- Soulé Commercial College and Literary Institute. [i]
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- Tulane University (includes Fisk Free Library, New Orleans Academy of Sciences, and University of Louisiana). [iii]

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Maine Board of Agriculture. [i]
Maine Insane Hospital. [i]
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Bangor.

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East Maine Conference Seminary. [i]

Cumberland Centre.

Greely Institute. [i]

Deering.

Westbrook Seminary (Frost Library). [i]

Eastport.

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Fort Preble.

Post Library of Fort Preble (see Portland).

Hebron.

Hebron Academy (Hamlin Library). [ii]

Kittery.

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Lewiston.

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Livermore.

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York Institute. [ii]

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Warren.

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Waterville.

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Johns Hopkins University. [iii]
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- Frederick College. [i]
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Hagerstown.
- Thursday Club Library and Reading Room. [i]

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- Amherst College. [iii]
- Lawrence Observatory. [i]
- Massachusetts Agricultural College. [ii]

Andover.
- Andover Theological Seminary. [iii]
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- Phillips Academy. [i]

Ashburnham.
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Billerica.
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Boston.
- American Academy of Arts and Sciences. [iii]
- American Board of Commissioners for Foreign Missions. [iii]
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- American Gynecological Society. [i]
- American Statistical Association. [iii]
- Appalachian Mountain Club [i]
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Horace Mann Day School for the Deaf and Dumb. [i]
Massachusetts College of Pharmacy. [i]
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Massachusetts Institute of Technology. [iii]
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Massachusetts Society for the Prevention of Cruelty to Animals. [i]
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New England Historic-Genealogical Society. [iii]
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Perkins Institution and Massachusetts School for the Blind. [i]
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Bradford.

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Cambridge.

Astronomical Observatory. [i]
Botanic Garden and Herbarium. [i]
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Centreville.
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College Hill.
Tufts College. [iii]

Concord.
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Danvers.
Peabody Institute and Library. [ii]

Easthampton.
Public Library Association. [i]

Fall River.
Fall River Public Library. [iii]

Florence.
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Gloucester.
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Greenfield.
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Groton.
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Hardwick.
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Harvard.
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Harwich.
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Haverhill.
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Holbrook.
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Ipswich.
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Jamaica Plains.
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Lancaster.
Lancaster Town Library. [iii]
Lawrence.
Lawrence Public Library. [iii]
Leicester.
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Lexington.
Carey Memorial Library. [ii]
Lowell.
Green School. [i]
Lowell City Library. [iii]
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Lynn.
Lynn Free Public Library. [ii]
Malden.
Malden Public Library. [i]
Manchester.
Manchester Public Library. [i]
Milford.
Milford Town Library. [i]
Monson.
Monson Academy (Flynt & Packard Library). [i]
Nahant.
Nahant Public Library. [i]
Nantucket.
Nantucket Athenæum. [iii]
New Bedford.
Free Public Library of New Bedford. [iii]
New Bedford High School. [i]
Newburyport.
Newburyport Public Library. [iii]
Newton.
Newton Free Library. [ii]
Newton Centre.
Newton Theological Institution. [iii]
Northampton.
Clarke Institution for Deaf-Mutes. [i]
Northampton Free Public Library. [iii]
Northampton Lunatic Hospital. [i]
Smith College for Women. [ii]

Northborough.
- Northborough Free Library. [i]

North Brookfield.
- North Brookfield Free Public Library. [i]

North Chelmsford.
- North Chelmsford Library Association. [i]

Peabody.
- Peabody Institute Library. [iii]

Pembroke.
- Pembroke Free Library Association. [i]

Pittsfield.
- Berkshire Athenæum. [i]

Quincy.
- Thomas Crane Public Library. [ii]

Roxbury.
- Dudley Association. [i]
- Fellows' Athenæum (formerly Roxbury Athenæum). [iii]

Salem.
- American Association for the Advancement of Science (office of Secretary). [i]
- Essex Institute. [iii]
- Peabody Academy of Science. [iii]
- Salem Athenæum. [iii]

Somerville.
- McLean Asylum for the Insane. [i]

South Braintree.
- Thayer Public Library. [i]

Southbridge.
- Southbridge Public Library. [i]

South Hadley.
- Mount Holyoke Female Seminary. [ii]
  - Observatory. [i]

South Natick.
- Historical and Natural History and Library Society. [ii]

South Scituate.
- James Library. [i]

Springfield.
- City Library Association. [iii]

Stockbridge.
- Jackson Library of Stockbridge. [i]

Taunton.
- Old Colony Historical Society. [i]
- Public Library. [iii]
- Taunton Lunatic Hospital. [i]

Tyngsborough.
Tyngsborough Public Library. [i]

Vineyard Haven.
Sailors' Free Library. [i]

Wakefield.
Beebe Town Library of Wakefield. [i]

Waltham.
Holmes Club. [i]
Waltham Public Library. [ii]

Wareham.
Wareham High School. [i]

Warren.
Warren Public Library. [i]

Watertown.
Free Public Library. [iii]

Wayland.
Wayland Free Public Library. [i]

Wellesley.
Wellesley College. [iii]

West Bridgewater.
West Bridgewater Public Library. [i]

West Roxbury.
West Roxbury Free Library. [i]

Weymouth.
Tufts Library. [i]

Wilbraham.
Wesleyan Academy. [i]

Williamstown.
Williams College. [iii]

Winchester.
Winchester Public Library. [ii]

Woburn.
Woburn Public Library. [iii]

Worcester.
American Antiquarian Society. [iii]
Free Public Library of the City of Worcester. [iii]
Holy Cross College. [iii]
State Normal School. [i]
Winslow Street Public School. [i]
Worcester County Free Institute of Industrial Science. [ii]
Worcester Lunatic Hospital. [i]
Worcester Lyceum and Natural History Association. [i]
Worcester Society of Antiquity. [i]

MICHIGAN.

Adrian.
- Adrian College. [iii]
  - Lambda Phi Society. [i]
- Adrian Scientific Society. [i]

Agricultural College.
- State Agricultural College (see Lansing).

Albion.
- Albion College. [iii]

Ann Arbor.
- Ann Arbor High School. [i]
- Observatory. [i]
- University of Michigan. [iii]

Battle Creek.
- Battle Creek College. [i]
- Battle Creek Public School Library. [i]
- Medical and Surgical Sanitarium. [i]

Coldwater.
- Free Public Library. [i]

Detroit.
- Detroit Medical and Library Association. [i]
- Detroit Public High School. [i]
- Detroit Scientific Association. [i]
- Michigan State Agricultural Society. [i]
- Public Library of the City of Detroit. [iii]

Eaton Rapids.
- Public Library of the City. [i]

Elm Hall.
- Elm Hall Graded School. [i]

Grand Haven.
- Union School Library. [i]

Grand Rapids.
- Kent Scientific Institute (of Grand Rapids High School). [i]
- Public School Library. [ii]
- West Michigan Farmers' Club. [i]

Hillsdale.
- Hillsdale College. [iii]

Kalamazoo.
- Kalamazoo College. [iii]
- Kalamazoo Public School Library. [i]
- Ladies' Library Association. [ii]
- Michigan Asylum for the Insane. [i]

Lansing.
Michigan State Library. [iii]
Michigan State Medical Society. [i]
State Agricultural College. [iii]
State Board of Education. [i]
State Board of Health. [i]

Monroe.
Monroe Young Ladies' Seminary. [i]

Niles.
Niles Public School Library. [i]

Olivet.
Olivet College. [ii]

Orchard Lake.
Michigan Military Academy. [i]

Port Huron.
Ladies' Library Association of Port Huron. [ii]

Saint Clair.
Somerville School for Young Ladies. [i]

South Haven.
South Haven Antiquarian Society. [i]

Spring Arbor.
Spring Arbor Seminary. [i]

Sumner.
Public School Library. [i]

Wayland.
Wayland Horticultural Society. [i]

West Bay City.
Sage Public Library. [i]

White Pigeon.
White Pigeon Grange (No. 304). [i]

Ypsilanti.
State Normal School. [i]
Ypsilanti Public School Library. [i]

MINNESOTA.

Albert Lea.
Albert Lea College for Young Ladies. [i]

Alexandria.
Alexandria Public Library. [i]

Austin.
Austin Natural History Society. [i]

Cannon River Falls.
Cannon River Falls Society of Natural Sciences. [i]

Claremont.

Claremont Public School Library. [i]

Duluth.

Kitchi Gammi Club. [i]
Ladies' Library Association of Duluth. [i]
Young Men's Christian Association Free Reading Room. [ii]

Faribault.

Minnesota Institution for the Education of the Deaf, Dumb, and Blind. [i]
Saint Mary's Hall School. [i]

Fort Snelling.

Medical Directors' Library of Headquarters Department of Dakota. [i]

Hamline.

Hamline University (formerly at Saint Paul). [i]

Mankato.

Second State Normal School. [i]

Minneapolis.

Geological and Natural History Survey of Minnesota. [i]
Minneapolis Athenæum. [i]
Minnesota Academy of Natural Sciences. [i]
University of Minnesota. [iii]

Northfield.

Carleton College. [ii]
  Observatory. [i]

Red Wing.

Red Wing Norwegian Evangelical Lutheran Seminary. [i]
Red Wing Ornithological Society. [i]
State Board of Health of Minnesota. [i]

Saint Cloud.

State Normal School. [ii]

Saint Paul.

Department of Public Instruction. [i]
Chamber of Commerce. [i]
Hamline University (see Hamline).
Macalester College. [i]
Minnesota Historical Society. [iii]
Saint Paul Academy of Natural Sciences. [i]
Saint Paul Public Library. [ii]
State Library. [iii]

Saint Peter.

Minnesota Hospital for the Insane. [i]

Stillwater.
Stillwater Library Association. [iii]

Winona.
State Normal School. [i]

MISSISSIPPI.

Agricultural College.
Agricultural and Mechanical College. [iii]

Blue Mountain.
Blue Mountain Female College. [i]

Byhalia.
Waverly Institute. [i]

Clinton.
Mississippi College. [i]
  Hermenian Society. [i]
  Philomathean Society. [i]

Columbus.
Columbus Public Library. [i]
Female Industrial College. [ii]

Corinth.
Graded High School. [i]

Daleville.
Cooper Institute. [ii]

Holly Springs.
Mississippi State Normal School. [i]

Jackson.
Institution for the Education of the Deaf and Dumb. [i]
Mississippi State Lunatic Asylum. [i]
State Library (S. I. publications transferred to Agricultural and Mechanical College).

Natchez.
Natchez Library Association. [i]

Oxford.
Union Female College. [i]
University of Mississippi. [iii]

Port Gibson.
Chamberlain-Hunt Academy. [i]

Rodney.
Alcorn Agricultural and Mechanical College. [i]

Summit.
Lea Female College. [i]

Washington.
Jefferson College (Academy). [ii]

West Point.
West Point Literary and Library Association. [i]

MISSOURI.

Ashley.

Watson Seminary. [i]

Avalon.

Avalon College of the United Brethren in Christ. [i]

Carthage.

Carthage Public School Library. [i]

Chillicothe.

Hazleton Public School Library. [i]

Clarksburg.

Hooper Institute. [i]

College Mound.

McGee College (see Pauline Holiness College).
Pauline Holiness College. [i]

Columbia.

Agricultural and Mechanical College. [i]
University of the State of Missouri. [iii]

Edinburgh.

Grand River College. [i]

Fayette.

Central College. [ii]

Fulton.

Missouri Institution for the Education of the Deaf and Dumb. [i]
State Lunatic Asylum. [i]

Glasgow.

Pritchett School Institute. [i]
Morrison Observatory. [i]

Grant City.

Grant City Reform Club. [i]

Jefferson City.

Missouri Historical Society (see Saint Louis).
Missouri State Library. [iii]

Kansas City.

Kansas City Academy of Sciences. [i]
Kansas City Public Library. [ii]
Query Club. [i]
Young Men's Christian Association. [i]

Kirksville.

North Missouri State Normal School. [iii]

La Grange.

La Grange College. [i]

Lebanon.

Le Clede Library Association. [i]

Liberty.

William Jewell College. [ii]

Monroe City.

Monroe Institute. [i]

Palmyra.

Saint Paul's College. [i]

Parkville.

Park College. [i]

Rolla.

Missouri School of Mines and Metallurgy (Department of University of Missouri at Columbia). [i]

Phelps County Agricultural, Mechanical, and Horticultural Society. [i]

Saint Joseph.

College of Physicians and Surgeons. [i]

Saint Joseph's Commercial College. [i]

Saint Louis.

College for Medical Practitioners. [i]

Law Library Association of Saint Louis. [i]

Missouri Botanical Gardens. [ii]

Missouri Historical Society. [i]

Missouri Medical College. [i]

Observatory of Washington University (see Washington University).

Odd Fellows' Library. [i]

Oldberg-Wall Laboratory. [i]

Polytechnic School (see Washington University).

Saint Louis Academy of Sciences. [iii]

Saint Louis Engineer Club. [i]

Saint Louis Mercantile Library. [iii]

Saint Louis Public School Library. [iii]

Saint Louis University. [iii]

Saint Louis Young Men's Christian Association. [i]

Union Literary Association. [i]

Washington University. [iii]

  Observatory. [i]

  Polytechnic School. [i]

Sedalia.

Sedalia Natural History Society. [i]

Springfield.

Drury College. [iii]

Stanberry.

Northwestern Normal School. [i]

Warrensburg.
- Public School Library. [i]
- State Normal School. [ii]

Warrenton.
- Central Wesleyan College. [i]

MONTANA.

Helena.
- Historical Society of Montana. [ii]
- Montana Library. [i]

NEBRASKA.

Crete.
- Crete Public Library. [i]
- Doane College. [ii]

Exeter.
- Unitarian Public Library Association. [i]

Lincoln
- Lincoln Public Library. [i]
- School Library. [i]
- State Library of Nebraska. [iii]
- University of Nebraska (State). [i]

Nebraska City.
- Otoe County Horticultural Society. [i]

Neligh.
- Gates College. [i]

Omaha.
- Creighton College. [i]
- Nebraska Institution for the Deaf and Dumb. [i]

Peru.
- State Normal School. [ii]

Wahoo.
- Luther Academy. [i]

NEVADA.

Carson City.
- State Library. [i]

NEW HAMPSHIRE.

Claremont.
- Fiske Free Library. [i]

Concord.
- New Hampshire Asylum for the Insane. [i]
- New Hampshire Board of Agriculture. [i]

Concord—Continued.
New Hampshire Historical Society. [iii]
New Hampshire State Library. [iii]
Saint Paul's School. [i]
State Board of Health. [i]
State Superintendent of Public Instruction. [i]

East Rindge.
East Rindge Library. [i]

Exeter.
Exeter Natural History Society. [i]

Great Falls.
Great Falls Manufacturers' and Village Library. [i]

Hanover.
Dartmouth College. [iii]
  Shattuck Observatory. [i]
New Hampshire College of Agriculture. [ii]

Hopkinton.
Hopkinton Public Library Association. [i]

Keene.
Keene Public Library. [i]

Littleton.
Littleton Graded School. [i]

Manchester.
Manchester City Library. [iii]

Marlborough.
Frost Free Public Library. [i]

Meriden.
Kimball Union Academy. [i]

Nashua.
Nashua Historical Society. [i]

New Hampton.
New Hampton Literary Institution. [i]

Peterborough.
Public Library. [i]

Portsmouth.
Portsmouth Athenæum. [iii]
Portsmouth Free Public Library. [ii]

Shaker Village.
Society of Shakers. [i]

Somersworth.
Great Falls Manufacturers' and Village Library (see Great Falls).

NEW JERSEY.

Atco.

Library and Natural Science Association. [i]

Beverly.

Trinity Hall School for Young Ladies. [i]

Bloomfield.

North Jersey Botanical Club. [i]

Burlington.

Burlington Library. [iii]

Hoboken.

Stevens Institute of Technology. [iii]

Hopewell.

Hopewell Seminary. [i]

Madison.

Drew Theological Seminary. [i]

Matawan.

Matawan Literary Society. [i]

Mont Clair.

Mont Clair Public High School. [i]
North Jersey Botanical Club (see Bloomfield).

Morristown.

Morristown Library and Lyceum. [ii]

Mount Holly.

Burlington County Lyceum of History and Natural Science. [i]

Newark.

Newark Library Association. [iii]
New Jersey Historical Society. [iii]

New Brunswick.

Gardner A. Sage Library of Theological Seminary. [ii]
Geological Survey of New Jersey. [i]
Rutgers College. [iii]
  Rutgers Grammar School. [i]
  Rutgers Scientific School. [i]

Newton.

Newton Library Association (Dennis Library). [ii]

Ocean Grove.

Ocean Grove Lyceum Library. [i]

Paterson.

Passaic County Historical Society. [i]
Paterson Board of Trade. [i]

Pennington.

Pennington Seminary and Female Collegiate Institute. [i]

Plainfield.
- Young Men's Christian Association. [i]

Princeton.
- College of New Jersey. [iii]
  - E. M. Museum of Geology and Archæology of the College of New Jersey. [ii]
  - Halsted Observatory. [i]
  - John C. Green School of Science. [i]
  - Observatory of Instruction. [i]
  - Theological Seminary of the Presbyterian Church. [iii]

Rahway.
- Rahway Library Association. [ii]

Trenton.
- New Jersey State Lunatic Asylum. [i]
- New Jersey State Normal and Model Schools. [ii]
- State Library of New Jersey. [iii]
- Trenton Natural History Society. [i]

Vineland.
- Vineland Historical and Antiquarian Society. [i]

Woodbridge.
- Barron Library. [i]

NEW MEXICO.

Santa Fé.
- Bureau of Immigration. [i]
- Historical Society of New Mexico. [i]
- Territorial Library. [i]
- University of New Mexico. [ii]

NEW YORK.

Albany.
- Albany College of Pharmacy. [i]
- Albany County Penitentiary. [i]
- Albany Institute. [i]
- Albany Law School. [i]
- Albany Medical College. [i]
- Dudley Observatory. [i]
- New York State Agricultural Society. [iii]
- New York State Library. [iii]
- New York State Museum of Natural History. [iii]
- New York State Normal School. [iii]
- Public School Library (formerly High School Library). [i]
- Young Men's Christian Association. [i]

Albion.
- Albion Union School. [i]
- Hart's Library and Reading Room. [i]

Alfred Centre.
  Alfred University. [ii]
    Observatory. [i]

Allegany.
  Saint Bonaventure's College and Seminary. [i]

Annandale.
  Saint Stephen's College. [ii]

Auburn.
  Cayuga County Historical Society. [i]
  Seymour Library Association. [ii]
  State Asylum for Insane Criminals. [i]
  Theological Seminary of Auburn. [ii]

Aurora.
  Wells' College for Young Ladies. [i]

Bath.
  Bath Library Association. [ii]

Blackwell's Island (near New York City).
  New York City Lunatic Asylum. [i]

Boonville.
  Boonville Union School and Academy. [i]

Brockport.
  Brockport Natural History Club. [i]
  State Normal School. [i]

Brooklyn.
  Adelphi Academy. [i]
  Brooklyn Entomological Society. [i]
  Brooklyn Institute (Youths' Free Library). [iii]
  Brooklyn Library. [iii]
  Club of Christian Endeavor. [i]
  Department of Health. [i]
  Long Island Historical Society. [iii]
  Packer Collegiate Institute. [ii]

Buffalo.
  Buffalo Historical Society. [i]
  Buffalo Practical School. [i]
  Buffalo Society of Natural Sciences. [iii]
  Buffalo Turn Verein. [i]
  Canisius College. [ii]
  Grosvenor Library. [iii]
  Le Conteulx Saint Mary's Institution for Deaf Mutes. [i]
  Young Men's Association and Library. [iii]
  Young Men's Christian Association. [i]

Canandaigua.
  Brigham Hall Hospital. [i]

Canton.
  Saint Lawrence University (Herring Library). [ii]
Clifton Springs.
  Foster School. [i]
Clinton.
  Hamilton College. [iii]
  Litchfield Observatory. [i]
Community.
  Oneida Community (Limited). [i]
Corning.
  Corning Library. [ii]
Cortland.
  State Normal School. [ii]
Elmira.
  Elmira Female College. [i]
  Young Men's Christian Association. [ii]
Fairfield.
  Fairfield Seminary. [i]
Fayetteville.
  Educational Council of Onondaga County. [i]
Flushing.
  Sanford Hall Asylum for Insane and Nervous Patients. [i]
Fordham.
  Saint John's College (see Tremont).
Fort Edward.
  Fort Edward Collegiate Institute. [i]
Fort Hamilton.
  Post Library, U. S. A. [i]
Fredonia.
  State Normal and Training School. [i]
Geneva.
  Hobart College. [iii]
  New York Agricultural Experiment Station. [i]
Gloversville.
  Levi Parsons Library. [i]
Goshen.
  Goshen Scientific Association. [i]
Governor's Island (New York Harbor).
  Free Military Service Institution (see New York City).
Hamilton.
  Madison University. [iii]
Hastings-on-Hudson.
  Henry Draper Observatory (see New York City).

Hornellsville.
- Hornell Free Academy. [i]
- Hornell Library Association. [ii]

Ilion.
- Ilion Public Library. [i]

Ithaca.
- Cornell University. [iii]

Jamestown.
- Jamestown Union School and Collegiate Institute. [i]

Le Roy.
- Ingham University. [i]

Lima.
- Genesee Wesleyan Seminary (formerly Genesee College). [iii]

Lisle.
- Lisle Union School and Academy. [i]

Little Valley.
- Little Valley Union Free School. [i]

Marathon.
- Marathon Academy. [i]

Mexico.
- Mexico Academy. [i]

Moriah.
- Sherman Academy. [i]

Mountainville.
- Houghton Farm Agricultural Library. [i]

Mount Lebanon.
- Society of Shakers. [i]

New Brighton.
- Natural Science Association of Staten Island. [i]

Newburgh.
- Newburgh Free Library. [iii]

New York City.
- Agassiz Association (Manhattan Chapter). [i]
- American Bible Society. [i]
- American Chemical Society. [i]
- American Geographical Society. [iii]
- American Institute of the City of New York. [iii]
- American Institute of Mining Engineers. [i]
- American Museum of Natural History. [iii]
- American Numismatic and Archæological Society. [i]
- American Society of Civil Engineers. [i]
- Astor Library. [iii]
- Board of Foreign Missions of the Presbyterian Church. [iii]

New York City—Continued.

Board of Home Missions of the Presbyterian Church. [i]
Bureau of Vital Statistics. [i]
Central Park Menagerie. [ii]
Century Club. [i]
Chamber of Commerce. [i]
College of the City of New York. [iii]
College of Pharmacy of the City of New York. [ii]
College of St. Francis Xavier. [iii]
Columbia College. [iii]
  School of Mines of Columbia College. [ii]
Cooper Union for the Advancement of Science and Art. [iii]
Department of Public Charities and Correction. [i]
Free Circulating Library of the Socialistic Labor Party. [i]
Fulton Market Fishmongers Association. [i]
General Society of Mechanics and Tradesmen (see New York Apprentices Library).
General Theological Seminary of the Protestant Episcopal Church. [iii]
Harlem Library. [i]
Health Department of the City of New York. [i]
Henry Draper Observatory (Mrs. Henry Draper, 271 Madison Avenue, Station L). [i]
House of Refuge (Randall's Island). [i]
Inventor's Institute (Cooper Union). [i]
Lenox Library. [iii]
Maimonides Library I. O. B. B. [iii]
Maritime Association of the Port of New York (Maritime Exchange). [i]
Medico-Legal Society of New York. [i]
Mercantile Library Association. [iii]
Metropolitan Museum of Art (Central Park). [iii]
Military Service Institution of the United States (New York Harbor). [i]
National Board of Fire Underwriters. [i]
New York Academy of Medicine. [ii]
New York Academy of Sciences. [iii]
New York Apprentices Library. [iii]
New York Board of Education. [i]
New York City Lunatic Asylum (Blackwell's Island). [i]
New York Free Circulating Library. [i]
New York Genealogical and Biographical Society. [i]
New York Historical Society. [iii]
New York Hospital. [i]
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New York Juvenile Asylum. [i]

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- New York Law Institute. [i]
- New York Meteorological Observatory (Central Park). [i]
- New York Microscopical Society. [i]
- New York Produce Exchange. [i]
- New York Society Library. [iii]
- New York Trade Schools. [i]
- Public School Teachers Association. [i]
- Rutger's Female College. [i]
- School of Mines (see Columbia College).
- Union Theological Seminary. [iii]
- United States Naval Lyceum. [i]
- University of the City of New York. [iii]
- Xavier Union of the City of New York. [i]
- Young Men's Christian Association. [iii]

North Brookfield.
- North Brookfield Union Free School. [i]

North Chili.
- Chili Seminary. [i]

Nunda.
- Nunda Union School. [i]

Onondaga.
- Onondaga Academy. [i]

Oswego.
- Oswego City Library. [ii]
- Oswego State Normal and Training School. [i]

Oxford.
- Oxford Academy. [i]

Penn Yan.
- Penn Yan Academy. [i]

Phelps.
- Red House Observatory. [i]
- Union and Classical School. [i]

Pike.
- Pike Seminary. [i]

Pine Plains.
- Seymour Smith Academy. [i]

Port Chester.
- Library and Reading Room. [i]

Poughkeepsie.
- Hudson River State Hospital. [i]
- Poughkeepsie City Library. [ii]
- Vassar Brothers Institute. [i]
- Vassar College. [iii]

Rochester.
Athenæum and Mechanics Association (see Reynolds Library).
Court of Appeals. [i]
Public School Central Library. [i]
Reynolds Library. [iii]
Rochester Society of Natural Sciences. [i]
Rochester Theological Seminary. [iii]
University of Rochester. [iii]
Warner Observatory. [i]
Western New York Institution for Deaf-Mutes. [i]

Rome.
Rome Academy. [i]

Round Lake.
Chatauqua Library (Alumni Hall). [i]

Schenectady.
Union College. [iii)

Schoharie.
Schoharie Academy and Union School. [i]

Sing Sing.
Dr. Parson's Private Home for Nervous Invalids. [i]
Sing Sing Prison Library. [i]

Skaneateles.
Skaneateles Library Association. [i]

Springville.
Springville Public Library. [i]
Springville Scientific Association. [i]

Suspension Bridge.
De Veaux College. [iii]
Niagara University (formerly Seminary of Our Lady of Angels). [i]

Syracuse.
Catholic Mutual Benefit Association. [i]
Central Library. [iii]
Onondaga Historical Association. [i]
Syracuse University. [iii]
Zeta Psi Society (Gamma Chapter). [i]

Tremont (formerly Fordham).
Saint John's College. [iii]

Troy.
Rensselaer Polytechnic Institute. [ii]
Rensselaer Society of Civil Engineers (formerly Pi Eta Scientific Society). [i]
Troy Female Seminary. [iii]
Troy Young Men's Association. [iii]
William Proudfit Observatory. [i]

Utica.
Oneida Historical Society. [i]
State Lunatic Asylum. [iii]
Young Men's Christian Association. [i]

West Chester.
Sacred Heart Academy. [i]

West Point.
United States Military Academy. [iii]
Observatory. [i]

White Plains.
West Chester County Historical Society. [i]

Whitestone.
Engineer School of Application of United States Army. [iii]

Willard.
Willard Asylum for the Insane. [i]

Yonkers.
Yonkers Free Reading Room. [i]
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NORTH CAROLINA.

Chapel Hill.
University of North Carolina. [iii]

Davidson College.
Davidson College. [iii]

Jonesborough.
High School. [i]

Lenoir.
Davenport Female College. [ii]
Pioneer Library of North Carolina. [i]

Mocksville.
Mocksville Male Academy. [i]

Moravian Falls.
Moravian Falls Academy. [i]

Olin.
Olin Male Academy. [i]

Raleigh.
North Carolina Agricultural Experiment Station. [i]
North Carolina Insane Asylum. [i]
North Carolina Institution for the Deaf, Dumb, and Blind. [i]
North Carolina State Library. [iii]

Salisbury.
Salisbury Graded School. [i]

Sparta.
Sparta Institute (Alleghanian Literary Society). [i]

Taylorsville.
Taylorsville Academy. [i]

Trap Hill.
Trap Hill Institute and Library. [i]

Trinity College.
Trinity College. [iii]

Wake Forest.
Wake Forest College. [ii]

Warrenton.
Warrenton Female Collegiate Institute. [ii]

Weaverville.
Weaverville College. [i]

Wilmington.
Historical and Scientific Society. [i]
State Board of Health. [i]

OHIO.

Akron.
Akron Scientific Club. [i]
Buchtel College. [i]

Albany.
Wells Library (see Lee).

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Barnesville.
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Bellaire.
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Cadiz.
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Caldwell.
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Carthage.
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Celina.

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  Observatory. [i]
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National Home for Disabled Volunteer Soldiers. [i]

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Portsmouth.

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Richmond College. [i]

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Women's Christian Temperance Union. [i]

Saint Clairsville.

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Savannah Academy and Scientific Association. [i]

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Heidelberg College. [iii]
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East Portland.
Oregon Hospital for the Insane. [i]

Eugene City.
University of Oregon. [iii]

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Tualatin Academy and Pacific University. [iii]

Philomath.
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Portland.

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Allegheny.

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Annville.

Lebanon Valley College. [i]

Beatty's Station.

Saint Vincent's Abbey and College. [i]

Beaver.

Beaver College and Musical Institute. [i]

Beaver Falls,

Geneva College. [i]

Bethlehem.

Lehigh University (see South Bethlehem).
Moravian College and Theological Seminary. [i]
Moravian Seminary for Young Ladies. [i]

Blairsville.

Blairsville Ladies' Seminary. [i]

Blossburg.

Graded Public High School. [i]

Brumfieldville.

Amity Library Association. [i]

Bryn-Mawr.

Bryn-Mawr College. [ii]

Butler.

Witherspoon Institute. [i]

California.

Southwestern State Normal School. [i]

Carlisle.

Dickinson College. [iii]

Clarion.

Carrier Seminary of Western Pennsylvania. [i]

Clearfield.

Leonard Literary Association and Library. [i]

Collegeville.
- Ursinus College. [i]

Concordville.
- Concord Select School (see Ward).

Danville.
- State Hospital for the Insane. [i]

Dixmont.
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Easton.
- American Institute of Mining Engineers. (Removed to New York City.)
- Easton Library. [ii]
- Lafayette College. [iii]

Edinborough.
- State Normal School. [i]
- Young Men's Christian Association. [i]

Elizabethville.
- Washington Literary Society. [i]

Erie.
- Erie Natural History Society. [i]
- Young Men's Christian Association. [i]

Frankford.
- Agassiz Association, Frankford Chapter. [i]
- Asylum for the Relief of Persons Deprived of their Reason (Philadelphia). [i]

Franklin.
- Franklin High School. [i]

Germantown.
- Friend's Free Library and Reading Room. [ii]
- Germantown Library Association. [ii]
- Workingmen's Club of Germantown. [i]

Gettysburg.
- Pennsylvania College. [iii]
- Theological Seminary of the General Synod of the Evangelical Lutheran Church. [iii]

Greensburg.
- Underwood Library. [i]

Greenville.
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Harrisburg.
- Dauphin County Historical Society. [i]
- Geological Survey (see Philadelphia.)
- Harrisburg Public School Library Association. [i]
- Pennsylvania State Library. [iii]
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- Haverford College. [iii]
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Hereford.
- Hereford Literary Society. [i]

Honesdale.
- Honesdale School Library. [ii]

Huntingdon.
- Huntingdon Public School Library. [i]
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Jefferson.
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Kirk's Mills.
- Fulton Farmers' Club. [i]

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Lancaster.
- Franklin and Marshall College. [iii
  - Göethean Literary Society. (i)
- Linnean Scientific and Historical Society. [i]

Lewisburg.
- University at Lewisburg. [iii]

Lincoln University.
- Lincoln University (formerly at Oxford). [iii]

Litiz.
- Linden Hall Seminary. [i]

Lock Haven.
- Central Normal School. [i]

Mansfield.
- State Normal School. [ii]

Marietta.
- Marietta Lyceum of Natural History. [i]

Meadville.
- Allegheny College. [iii]
- Library, Art and Historical Association (formerly City or Public Library). [ii]
- Meadville Theological School. [iii]
- Public High School of the City of Meadville. [i]

Mechanicsburg.
- Mechanicsburg Library and Literary Society. [i]

Media.
- Delaware County Institute of Science. [iii]

Mercersburg.
Washington Irving Literary Society of Mercersburg College. [i]

Millersville.
State Normal School of Second District. [i]

Monongahela City.
Hazzard Institute Library. [i]

Muncy.
Muncy Normal School. [i]

Natrona.
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New Brighton.
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New Lebanon.
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New Wilmington.
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Norristown.
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Orwell.
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Overbrook.
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Oxford.
Lincoln University (see Lincoln University).
Oxford Library. [i]

Philadelphia.
Academy of Natural Sciences. [iii]
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Athenæum of Philadelphia. [iii]
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Board of Health of the City and Port of Philadelphia. [i]
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Central High School. [ii]
College of Physicians of Philadelphia. [i]
Eastern State Penitentiary. [i]
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Franklin Institute. [iii]
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- German Society. [iii]
- Girard College for Orphans. [iii]
- Girls' Grammar School for the Second School Section. **[i]**
- Historical Society of Pennsylvania. [iii]
- Home for F. and A. Masons (Masonic Temple). [ii]
- La Salle College. [i]
- Library Association of Friends of Philadelphia. [iii]
- Library Company of Philadelphia. [iii]
- Mercantile Library Company of Philadelphia. [iii]
- Naval Hospital. [i]
- Nebinger Boys' Grammar School. [i]
- Numismatic and Antiquarian Society of Philadelphia. **[i]**
- Pennsylvania Academy of the Fine Arts. [i]
- Pennsylvania Board of Public Charities. [i]
- Pennsylvania Hospital. [iii]
- Pennsylvania Hospital for the Insane. [i]
- Pennsylvania Institution for the Deaf and Dumb. [i]
- Pennsylvania Institution for the Instruction of the Blind. [i]
- Philadelphia Association of Manufacturers of Textile Fabrics. **[i]**
- Philadelphia Board of Trade. [i]
- Philadelphia Club. [i]
- Philadelphia College of Pharmacy. [iii]
- Philadelphia Drug Exchange. [i]
- Philadelphia Maritime Exchange. [i]
- Philadelphia School of Design for Women. **[i]**
- Philadelphia Social Science Association. **[i]**
- Presbyterian Board of Publication. [iii]
- Presbyterian Historical Society. [i]
- Preston Retreat. [i]
- St. Clement's Workingmen's Club and Institute. **[i]**
- Second Geological Survey of Pennsylvania (removed from Harrisburg). [i]
- Southwark Library. [iii]
- Teachers' Institute of the City and County of Philadelphia. **[i]**
- Union League Club. [i]
- University of Pennsylvania. [iii]
- Wagner Free Institute of Science. [i]
- West Philadelphia Medical Book Club. **[i]**
- Young Men's Christian Association. [ii]
- Zoological Society of Philadelphia. [i]

Pittsburgh.

- German Library Association (Deutscher Leseverein). **[i]**
- Mercantile Library (see Pittsburg Library Association).
- Pennsylvania Female College. [ii]
- Pittsburgh College of Pharmacy. [i]

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- Pittsburgh Female College. [ii]
- Pittsburgh Library Association. [iii]

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- Reading Library. [iii]
- Reading Society of Natural Sciences. [i]
- Saint Paul's Church Library. [i]
- Spencer F. Baird Naturalists' Association. [i]

Rimersburg.
- Clarion Collegiate Institute. [i]

Scranton.
- Scranton High School. [i]
- Young Men's Christian Association. [i]

Sewickley.
- Sewickley Academy. [i]
- Sewickley Public Library. [i]

Sheakleyville.
- Sheakleyville Academy. [i]

South Bethlehem.
- Lehigh University. [iii]
  - Sayre Observatory. [i]

South Hermitage.
- Pequea Presbyterian Church Public Library. [i]

State College.
- Pennsylvania State College. [ii]

Swarthmore.
- Swarthmore College Library. [iii]

Tarentum.
- Odd Fellows' Library. [i]

Titusville.
- Titusville Library Association. [i]

Towanda.
- Scientific Society of Susquehanna Institute. [i]

Troy.
- Troy Graded and High School Library. [i]

Turtle Creek.
- Western Pennsylvania Institution for the Deaf and Dumb. [i]

Wallingford.
- Wallingford Natural History Society. [i]

Ward.
- Ward Academy (formerly Concord Select School). [i]

Warren.
- Warren Public Library. [i]

Washington.

Washington and Jefferson College. [iii]

Waynesburg.

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Wellsborough.

Academic Literary Society. [i]

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Aiken.

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Cedar Spring.

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Elliot Society of Science and Art (formerly Elliot Society of Natural History). [i]
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Newberry.

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Bloomington.

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Chattanooga.

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Clarksville.

Southwestern Presbyterian University (successor to Stuart College). [i]

Cog Hill.

Cane Creek Collegiate Institute. [i]

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- Columbia Athenæum. [ii]
- Female Institute. [i]

Gallatin.
- Howard Female College. [i]

Greeneville.
- Greeneville and Tusculum College (see Tusculum).

Hiwassee College.
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Jackson.
- Southwestern Baptist University. [ii]

Knoxville.
- East Tennessee University and Agricultural College (see University of Tennessee).
- Public Library of Knoxville. [i]
- Tennessee School for the Deaf and Dumb. [i]
- University of Tennessee (formerly East Tennessee University). [iii]

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- Lewisburg Institute. [i]

Maryville.
- Maryville College and Theological Seminary. [iii]

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McMinnville.
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  - Montgomery Bell Academy. [i]
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- Tennessee School for the Blind. [ii]
- Tennessee State Library. [iii]
- University of Nashville. [iii]
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Wayside Academy. [i]

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Austin.

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Campbell.

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Center High School. [i]

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Southwestern University. [i]

Gilmer.
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Kingston.
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Longview.
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Mineola.
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Austin College. [i]

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Barnet.
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Brattleborough.
Vermont Asylum for the Insane. [i]

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Fletcher Free Library. [iii]
Public School Department. [i]
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Cutting's Public Library and Museum. [i]

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Sheldon's Art Museum Archæological and Historical Society. [i]

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Northfield.
Lewis College (formerly Norwich University). [i]

Randolph.
State Normal School. [i]

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- Saint Johnsbury Athenæum. [iii]
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Strafford.
- Harris Library (Public Library). [ii]

Thetford.
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- Thetford Academy. [i]

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- Windsor Library Association. [i]

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Alexandria.
- Episcopal High School of Virginia. [i]

Ashland.
- Randolph Macon College. [iii]

Blacksburg.
- Virginia Agricultural and Mechanical College. [ii]

Christiansburg.
- Montgomery Female College. [i]

Crozet.
- Miller Manual School. [i]

Culpeper.
- Piedmont Agricultural Society. [i]

Emory.
- Emory and Henry College. [iii]

Fortress Monroe.
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Hampden Sidney.
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Hampton.
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- Young Men's Christian Association. [i]

Lexington.
- Virginia Military Institute. [iii]
- Washington and Lee University. [iii]
  - School of Civil and Mining Engineering. [i]

National Soldiers' Home.
- Soldiers' Home (Southern Branch). [i]

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- Polytechnic Institute. [ii]

Norfolk.
- United States Naval Hospital. [i]
- Norfolk Mission College. [i]
- Webster Literary and Scientific Institute. [i]

Norwood.
- Norwood High School and College. [i]

Petersburg.
- Petersburg Benevolent Mechanics' Association. [i]
- Virginia Normal and Collegiate Institute. [i]

Richmond.
- Richmond Academy of Medicine. [i]
- Richmond College. [iii]
- Richmond High School. [i]
- Virginia Department of Agriculture. [i]
- Virginia Historical Society. [iii]
- Virginia State Library. [iii]
- Young Men's Christian Association. [i]

Salem.
- Roanoke College. [iii]

Snowville.
- Snowville Library Association. [i]

Theological Seminary.
- Protestant Episcopal Theological Seminary. [iii]

Unison.
- Unison Public Library. [i]

University of Virginia.
- University of Virginia. [iii]
- Leander McCormick Observatory. [i]

Williamsburgh.
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Anacortes.
- Alden Academy. [i]

Cheney.
- Cheney (Benjamin P.) Academy. [i]

Dayton.
- Dayton Library Association. [i]

Fort Steilacoom.
- Hospital for the Insane. [i]

Olympia.
- Territorial Library. [i]

Seattle.
- Public School Library (Denning School). [i]

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- University of Washington Territory. [ii]
- Yesler College. [i]

Spokane Falls.
- Spokane Library Association. [i]

Tacoma.
- Annie Wright Seminary. [i]
- Tacoma Chamber of Commerce. [i]

Vancouver.
- Vancouver College. [i]

Walla Walla.
- Association for the Advancement of Science. [i]
- Whitman College and Seminary. [ii]

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Bethany College.
- Bethany College. [iii]

Charleston.
- State Library. [iii]

Flemington.
- West Virginia College. [ii]

Huntington.
- Huntington Public School Library. [i]
- Marshall College (State Normal School). [i]

Huttonsville.
- Agricultural and Pomological Society. [i]

Morgantown.
- Morgantown Female Seminary. [i]
- West Virginia University and Agricultural College. [iii]

Romney.
- West Virginia Institute for the Deaf, Dumb, and Blind. [i]

Shepherdstown.
- Shepherd College. [i]

Weston.
- West Virginia Hospital for the Insane. [i]

Wheeling.
- State Library (see Charleston).
- Wheeling Public Library. [i]

WISCONSIN.

Antigo.
- Wisconsin Geographical Society. [i]

Appleton.
- Lawrence University (Appleton Library). [iii]

Beaver Dam.

Beaver Dam Public Library. [i]
Wayland University. [i]

Beloit.

Beloit College. [iii]

Burlington.

Burlington School Library. [i]

Delavan.

Institution for the Education of the Deaf and Dumb. [i]

De Pere.

Agassiz Association. Chapter B. No. 148. [i]

Evansville.

Evansville Seminary. [i]

Franklin.

College of the Mission of the Northwestern Synod of the Reformed Church. [i]

Galesville.

Galesville University. [i]

Janesville.

Wisconsin Institution for the Education of the Blind. [i]

Lake Geneva.

Lake Geneva Seminary. [i]

Madison.

Madison High School. [i]
State Agricultural Society. [i]
State Historical Society of Wisconsin. [iii]
University of Wisconsin. [iii]
  Washburn Observatory. [i]

Mendota.

Wisconsin State Hospital for the Insane. [i]

Milwaukee.

Milwaukee College (female). [i]
Mortimer Memorial Library. [i]
Milwaukee Public Library (formerly Young Men's Association Library). [iii]
Milwaukee Public School Teachers' Library. [i]
National Home for Disabled Volunteer Soldiers (Northwestern Branch). [i]
Naturhistorischen Verein. [i]
Public Museum of the City of Milwaukee. [i]
Wisconsin Natural History Society. [i]
Young Men's Association Library (see Milwaukee Public Library).
Young Men's Christian Association. [i]

Osceola Mills.
- Osceola Graded School (successor to High School). [i]

Platteville.
- Wisconsin State Normal School. [iii]

Racine.
- Racine College. [iii]

Ripon.
- Ripon College. [i]

River Falls.
- State Normal School. [i]

Shawano.
- Shawano City High School. [i]

Sinsinawa.
- Saint Clara Academy (female). [i]

Watertown.
- Watertown High School. [i]

Waupun.
- Waupun Library Association. [i]

Whitewater.
- State Normal School. [i]

WYOMING TERRITORY.

Cheyenne.
- Territorial Library. [ii]
- Wyoming Academy of Art, Science, and Letters. [i]

Laramie City.
- Public School Library. [i]
- Wyoming Library and Literary Association. [i]

CIRCULAR RELATIVE TO A MATHEMATICAL PRIZE.

Prof. SPENCER F. BAIRD,

SIR: I beg to transmit to you the following communication, that will shortly appear in the journal *Acta Mathematica*, of which I am chief editor:

"His Majesty Oscar II wishing to give a fresh proof of his interest in the advancement of mathematical science, an interest already manifested by his graciously encouraging the publication of the journal Acta Mathematica, which is placed under his august protection, has resolved to award a prize, on the 21st of January, 1889, the sixtieth anniversary of his birthday, to an important discovery in the field of higher mathematical analysis. This prize will consist in a gold medal of the eighteenth size bearing His Majesty's image and having a value of a thousand francs, together with a sum of two thousand five hundred crowns (1 crown equal to about 1 franc 40 centimes).

"His Majesty has been pleased to intrust the task of carrying out His intentions to a commission of three members, Mr. Carl Weierstrass in Berlin, Mr. Charles Hermite in Paris, and the chief editor of this journal, Mr. Gösta Mittag Leffler in Stockholm. The commissioners having presented a report of their work to His Majesty, he has graciously signified his approval of the following final propositions of theirs:

"Having taken into consideration the questions which from different points of view equally engage the attention of analysts, and the solution of which would be of the greatest interest for the progress of science, the commission respectfully proposes to His Majesty to award the prize to the best memoir on one of the following subjects:

"1. A system being given of a number whatever of particles attracting one another mutually according to Newton's law, it is proposed, on the assumption that there never takes place an impact of two particles, to expand the co-ordinates of each particle in a series proceeding according to some known functions of time and converging uniformly for any space of time.

"It seems that this problem, the solution of which will considerably enlarge our knowledge with regard to the system of the universe, might be solved by means of the analytical resources at our present disposition; this may at least be fairly supposed, because shortly before his death Lejeune-Dirichlet communicated to a friend of his, a mathematician, that he had discovered a method of integrating the differential equations of mechanics, and that he had succeeded, by applying this method, to demonstrate the stability of our planetary system in an absolutely strict manner. Unfortunately we know nothing about this method, except that the starting point for its discovery seems to have been the theory of infinitely small oscillations.* It may however be supposed almost with certainty that this method was not based on long and complicated calculations, but on the development of a simple fundamental idea, which one may reasonably hope to find again by means of earnest and persevering study.

"However, in case no one should succeed to solve the proposed problem within the period of the competition, the prize might be awarded to a work in which some other problem of mechanics is treated in the indicated manner and completely solved.

"2. Mr. Fuchs has demonstrated in several of his memoirs† that there exist uniform functions of two variables which, by their mode of generation, are connected with the ultra elliptical functions, but are more general than these, and which would probably acquire great importance for analysis, if their theory were further developed.

"It is proposed to obtain, in an explicit form, those functions whose existence has been proved by Mr. Fuchs, in a sufficiently general case, so as to allow of an insight into and study of their most essential properties.

"3. A study of the functions defined by a sufficiently general differential equation of the first order, the first member of which is a rational integral function with respect to the variable, the function, and its first differential coefficient.

"Mr. Briot and Mr. Bouquet have opened the way for such a study by their memoir on this subject (Journal de l'école polytechnique, cahier 36, pp. 133–198). But the mathematicians acquainted with the results attained by these authors know also that their work has not by far exhausted the difficult and important subject which they have first treated. It seems probable that, if fresh inquiries were to be undertaken in the same direction, they might lead to theorems of high interest for analysis.

"4. It is well known how much light has been thrown on the general theory of algebraic equations by the study of the special functions to which the division of the circle into equal parts and the division of the argument of the elliptic functions by a whole number lead up. That remarkable transcendant which is obtained by expressing the module of an elliptic function by the quotient of the periods leads likewise to the modulary equations that have been the origin of entirely new notions and highly important results, as the solution of equations of the fifth degree. But this transcendant is but the first term, a particular case and that the simplest one of an infinite series of new functions introduced into science by Mr. Poincaré under the name of 'fonctions fuchsiennes' and *successfully* applied by him to the integration of lineary differential equations of any order. These functions, which accordingly have a *rôle* of manifest importance in analysis, have not as yet been considered from an algebraical point of view as the transcendant of the theory of elliptic functions of which they are the generalization.

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* See p. 35 of the Panegyric on Lejeune-Dirichlet by Kummer, Abhandlungen der K. Akademie der Wissenschaften zu Berlin, 1860.

† These memoirs are to be found in—(1) Nachrichten von der K. Gesellschaft der Wissenschaften zu Göttingen, February, 1880, p. 170. (2) Borchardt's Journal, Bd. 89, p. 251. (A translation of this memoir is to be found in the Bulletin of Mr. Darboux, 2:me série, t. IV.) (3) Nachrichten von der K. Gesellschaft der Wissenschaften zu Göttingen, June, 1880, p. 445 (translated into French in the Bulletin of Mr. Darboux, 2me série, t. IV). (4) Borchardt's Journal, Bd. 90, p. 71 (also in the Bulletin of Mr. Darboux, 2me série, t. IV). (5) Abhandlungen der K. Gesellschaft der Wissenschaften zu Göttingen, 1881 (Bulletin of Mr. Darboux, t. V). (6) Sitzungsberichte der K. Akademie der Wissenschaften zu Berlin, 1883, I, p. 507. (7) The memoir of Mr. Fuchs published in Borchardt's journal, Bd. 76, p. 177, has also some bearings on the memoirs quoted.

"It is proposed to fill up this gap and to arrive at new equations analogous to the modulary equations by studying, though it were only in a particular case, the formation and properties of the algebraic relations that connect two 'fonctions fuchsiennes' when they have a group in common.

"In case none of the memoirs tendered for competition on any of the subjects proposed above should be deemed worthy of the prize, this may be adjudged to a memoir sent in for competition that contains a complete solution of an important question of the theory of functions other than those proposed by the commission.

"The memoirs offered for competition should be furnished with an epigraph, and, besides, with the author's name and place of residence in a sealed cover, and directed to the chief editor of the Acta Mathematica before the first of June, 1888.

"The memoir to which His Majesty shall be pleased to award the prize as well as that or those memoirs which may be considered by the commission worthy of an honorary mention, will be inserted in the Acta Mathematica, nor can any of them be previously published.

"The memoirs may be written in any language that the author chooses, but as the members of the commission belong to three different nations the author ought to subjoin a French translation to his original memoir, in case it is not written in French. If such a translation is not subjoined, the author must allow the commission to have one made for their own use.

"THE EDITORS OF THE ACTA MATHEMATICA."

I hope you will take an interest in this communication, and am, sir, yours, very respectfully,

G. MITTAG LEFFLER,

Member of the Academy of Science, Professor of the Stockholm University, Chief Editor of the Acta Mathematica.

ACTS AND RESOLUTIONS OF CONGRESS RELATIVE TO THE SMITHSONIAN INSTITUTION, NATIONAL MUSEUM, ETC.

IN CONTINUATION FROM PREVIOUS REPORTS.

NATIONAL MUSEUM.

Furniture and fixtures, National Museum: To pay sundry bills for miscellaneous fixtures and for glass for exhibition cases for the National Museum, being for the service of the fiscal year ending June thirtieth, eighteen hundred and eighty-four, two thousand eight hundred and ninety-one dollars and forty-two cents.

Preservation of collections, National Museum: To meet expenses of receiving, packing, transporting to Washington, and installing or storing such new specimens and collections as may be presented to the United States at the New Orleans Exposition, to be available for the fiscal years ending June thirtieth, eighteen hundred and eighty-five and eighteen hundred and eighty-six, five thousand dollars.

For cost of restoring the collections sent to the New Orleans Exposition to their proper places in the National Museum, including repair of cases and renewal of glass, to be available for the fiscal years ending June thirtieth, eighteen hundred and eighty-five and eighteen hundred and eighty-six, two thousand five hundred dollars.

(Act to supply deficiencies, &c. Approved March 3, 1885, chapter 359, page 463.)

For heating and lighting the National Museum: For expense of heating, lighting, and telephonic and electrical service for the new Museum building, nine thousand dollars.

For the preservation of collections of the National Museum: For the preservation and exhibition and increase of the collections received from the surveying and exploring expeditions of the Government, and other sources, including salaries or compensation of all necessary employés, ninety-five thousand dollars.

For the preservation of collections of the National Museum in the Armory building: For care of the Armory building and grounds, and expense of watching, preservation, and storage of the property of the National Museum and of the United States Fish Commission contained therein, including salaries or compensation of all necessary employés, two thousand five hundred dollars.

For furniture and fixtures of the National Museum: For cases, furniture, and fixtures required for the exhibition of the collections of the

United States National Museum, and for salaries or compensation of all necessary employés, forty thousand dollars.

(Sundry civil appropriation act. Approved March 3, 1885, chapter 360, page 501.)

SMITHSONIAN INSTITUTION.

International exchanges, Smithsonian Institution: For expenses of the system of international exchanges between the United States and foreign countries, under the direction of the Smithsonian Institution, including salaries or compensation of all necessary employés, ten thousand dollars.

North American Ethnology, Smithsonian Institution: For the purpose of continuing ethnological researches among the American Indians, under the direction of the secretary of the Smithsonian Institution, including salaries or compensation of all necessary employés, forty thousand dollars.

Smithsonian Institution Building: For finishing and completing the furnishing of the eastern portion of the Smithsonian Institution building, five thousand six hundred dollars.

(Sundry civil appropriation act. Approved March 3, 1885, chapter 360, page 494.)

NAVAL OBSERVATORY.

For payment to Smithsonian Institution for freight on Observatory publications sent to foreign countries, three hundred and thirty-six dollars.

(Legislative, executive, and judicial appropriation act. Approved March 3, 1885, chapter 343, page 415.)

WAR DEPARTMENT.

For the transportation of reports and maps to foreign countries: For the transportation of reports and maps to foreign countries, through the Smithsonian Institute, two hundred dollars.

(Sundry civil appropriation act. Approved March 3, 1885, chapter 360, page 507.)

ARMY MEDICAL MUSEUM.

An act providing for the erection of a building to contain the records, library and museum of the Medical Department, United States Army.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That a brick and metal fireproof building, to be used for the safe-keeping of the records, library, and museum of the Surgeon-General's Office of the United States Army, is hereby authorized to be constructed upon the Government reservation in the city of Washington, in the vicinity of the National Museum and the Smithsonian Institution, on a site to be selected by a commission composed of the Secretary of War, the Architect of the Capitol, and the Secretary of the Smithsonian Institution, and in accordance with plans and specifications submitted by the Surgeon-General of the Army and approved by said commission, the cost of the building when completed not to exceed the sum of two hundred thousand dollars, the building to be erected and the money expended under the direction and superintendence of the Secretary of War.

SEC. 2. That the sum of two hundred thousand dollars is hereby appropriated, out of any moneys in the Treasury not otherwise appropriated, for the commencement and completion of said building.

(Approved March 2, 1885, Statutes Forty-eighth Congress, second session, chapter 315, page 339.)

PRINTING.

Joint resolution providing for the printing and distribution of the Descriptive Catalogue of Government Publications.

[Public, No. 7, Forty-eighth Congress, second session.]

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed and half-bound in leather, with the exception of the reserve sets, which shall be full-bound in leather, six thousand six hundred copies of the Descriptive Catalogue of Government Publications, of which * * * two copies shall be for the use of the Smithsonian Institution.

(Approved February 9, 1885. Statutes Forty-eighth Congress, second session, pages 516, 517.)

Joint resolution providing for printing the sixth and seventh annual reports of the Director of the Bureau of Ethnology.

[Public, No. 16, Forty-eighth Congress, second session.]

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed at the Government Printing Office fifteen thousand five hundred copies each of the sixth and seventh annual reports of the Director of the Bureau of Ethnology, with accompanying papers and illustrations, and uniform with the preceding volumes of the series; of which three thousand five hundred shall be for the use of the Senate, seven thousand for the use of the House of Representatives, and five thousand for distribution by the Bureau of Ethnology.

(Approved March 2, 1885. Statutes Forty-eighth Congress, second session, page 519.)

Joint resolution to provide for printing the annual reports of the Smithsonian Institution.

[Public, No. 19, Forty-eighth Congress, second session.]

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the annual reports of the Smithsonian Institution shall be hereafter printed at the Government Printing Office, in the same manner as the annual reports of the heads of Departments are now printed, for submission in print to the two houses of Congress.

(Approved March 3, 1885. Statutes Forty-eighth Congress, second session, page 520.)

Concurrent resolution to print extra copies of the Smithsonian Report for 1884.

Resolved by the Senate (*the House of Representatives concurring*), That the Annual Report of the Smithsonian Institution and National Museum for the year 1884 be printed, and that there be printed 16,060 extra copies; of which 3,000 copies shall be for the use of the Senate, 6,060 for the use of the House of Representatives, and 7,000 for the use of the Smithsonian Institution.

(Concurrent resolution passed by the Senate [S. R. No. 114], January 26, 1885; passed by the House of Representatives February 4, 1885.)

GENERAL APPENDIX

OF THE

SMITHSONIAN REPORT FOR 1885.

ADVERTISEMENT.

The object of the GENERAL APPENDIX is to furnish summaries of scientific discovery in particular directions; occasional reports of the investigations made by collaborators of the Institution; memoirs of a general character or on special topics, whether original and prepared expressly for the purpose, or selected from foreign journals and proceedings; and briefly to present (as fully as space will permit) such papers not published in the "Smithsonian Contributions" or in the "Miscellaneous Collections" as may be supposed to be of interest or value to the numerous correspondents of the Institution.

RECORD OF SCIENTIFIC PROGRESS FOR 1885.

INTRODUCTION.

While it has been a prominent object of the Board of Regents of the Smithsonian Institution, from a very early date in its history, to enrich the annual report, required of them by law, with scientific memoirs illustrating the more remarkable and important developments in physical and biological discovery, as well as showing the general character of the operations of the Institution, this purpose was not carried out on any very systematic plan until the year 1880. Believing however that an annual report or summary of the recent advances made in the leading departments of scientific inquiry would supply a want very generally felt, and would be favorably received by all those interested in the diffusion of knowledge, the Secretary had prepared for the report of 1880, by competent collaborators, a series of abstracts showing concisely the prominent features of recent scientific progress in astronomy, geology, physics, chemistry, mineralogy, botany, zoölogy, and anthropology.

The same general programme has been followed in the subsequent reports, with the inclusion of geography and meteorology in the list of subjects. The contributors to this record for the present year, and their several departments or topics, remain substantially the same as in previous reports, though with some omissions, much to be regretted.

Prof. Edward S. Holden had prepared as usual the summary of astronomical progress for 1885, but having accepted the presidency of the University of California, with the directorship of the Lick Observatory on Mount Hamilton, in the confusion of moving from his late position at Madison, Wis., unfortunately mislaid his manuscript. At his request Mr. William C. Winlock, of the Naval Observatory at Washington, undertook, on short notice, to supply the deficiency. This he has satisfactorily accomplished.

Dr. T. Sterry Hunt, owing to the pressure of his important duties, has again been prevented from supplying the expected summary of progress in geology.

Commander Francis M. Green (U. S. N.), having been ordered to sea-duty on a three-years' cruise, has also been prevented from furnishing his accustomed *résumé* of advances in geographical knowledge. This chapter has for the present been supplied by Mr. J. King Goodrich.

Prof. Cleveland Abbe has, unfortunately, been unable to furnish his usual survey of the advances made in the department of meteorology, and the time did not permit an attempt to obtain a substitute in this important field.

Prof. William G. Farlow's record of progress in botany, omitted from the last report, is, from unforeseen circumstances, again omitted from this.

With every effort to secure prompt attention to all the more important details of such a work, various unexpected delays frequently render it impracticable to obtain all the desired reports in each department within the time prescribed. In such cases it is designed, if possible, to bring up deficiencies and supply them in subsequent reports.

The value of this annual record of progress would be much enhanced by an enlargement of its scope, and the inclusion, not only of such branches as mathematics, physiology, pathology, and medicine, microscopy, &c., but also of the more practical topics of agriculture and horticultural economy, engineering, mechanics, and technology in general; but the space required for such larger digest seems scarcely available in the present channel.

It is hardly necessary to remark that in a summary of the annual progress of scientific discovery so condensed as the present, the wants of the specialist in any branch can be but imperfectly supplied; and very many items and details of great value to him must be entirely omitted. While the student in a special field of knowledge may occasionally receive hints that will be found of interest, he will naturally be led to consult for fuller information the original journals and special periodicals from which these brief notices or abstracts have been compiled.

The plan of devoting some 350 pages of the annual report to such a compilation is not designed to preclude the introduction into the "General Appendix," as heretofore, of special monographs or discussions that may prove interesting to the scientific student.

SPENCER F. BAIRD.

ASTRONOMY.

By William C. Winlock,

Assistant Astronomer, United States Naval Observatory.

The following record of the progress of Astronomy during the year 1885 is in continuation of the records of past years, and it is given in essentially the same form. The annual review of astronomy has previously been prepared by Prof. Edward S. Holden, formerly director of the Washburn Observatory, Madison, Wis.; and the manuscript of the review for 1885 was entirely prepared by him in October and November of that year. Very unfortunately all but a small portion of this manuscript was lost in transferring Professor Holden's library from Madison to California, and Professor Holden, unable, on account of pressing official duties, to repair the loss, has asked me to make up the deficiency. This I have attempted to do, but wish to record the circumstances here, in order that I may plead the brief time available as an excuse for any shortcomings that may be found.

This record is primarily intended for the large and increasing class of those who have a general rather than a special interest in the progress of Astronomy, but it may be of use to professional astronomers also, as a convenient collection of reviews and notes. Abstracts of some of the most important papers are given, while other papers can appear by title only. As in previous years free use has been made of reviews, &c., in all accessible periodicals, particularly of those in *The Observatory*, *Bulletin Astronomique*, *Nature*, *The Athenæum*, and *Science*, and it is hoped that where specific reference to the source of information has been impracticable, this general acknowledgment will be accepted.

W. C. W.

COSMOGONY.

Faye: Sur l'Origine du Monde. Théories cosmogoniques des Anciens et des Modernes. Paris: Gauthier-Villars, 1884. *8vo.*—" Cosmic hypotheses vary from time to time; they have their history, in which they reflect the progress of human intelligence. At first closely connected with religious ideas, they have little by little lost their sacred character, and have become simple questions of celestial mechanics and general physics.

It cannot be denied, moreover, that they offer a broad field for the discoveries and theories that from time to time transform and, as it were, renew science. The mechanical theory of heat and spectrum analysis have inaugurated a new era for speculations concerning the origin of the world and the constitution of the universe, by furnishing to theoretical reasoning a basis incomparably more sure than that possessed at the time of Laplace. It is quite natural, therefore, that scholars should again turn their attention to the chaos from which the stars were born, and that, with the aid of the knowledge gained during the last century, they should undertake to submit the current cosmical theories to searching examination.

"M. Faye's book upon this subject will be welcomed, as it comes at a moment when attention is everywhere beginning to turn to these obscure and sublime questions. A large part of the book is devoted to the history of cosmogonies, beginning with that of Moses; and every reader will be pleased that M. Faye has taken pains to give always the original text, accompanying it by comments and remarks. The book contains extracts from *Genesis*, Plato's *Timæus*, Aristotle's *Heavens*, Cicero's *De Republica*, the poem of *Lucrece*, Descartes' *World*, Newton's *Principia*, Kant's *Allgemeine Natur-Geschichte und Theorie des Himmels* and *Beweisgrund zu einer Demonstration des Daseins Gottes*, Laplace's *Exposition du Système du Monde*, and from M. Hirn's *Analyse élémentaire de l'Univers.* After this historical exposition of ancient and modern cosmical ideas M. Faye proceeds to consider in his turn the problem of the formation of the universe and of the solar system.

"M. Faye regards Laplace's celebrated cosmic hypothesis, which is still accepted in treatises on astronomy, as quite opposed to science in its present state; he says that it cannot be reconciled with the retrograde motions of the satellites of Uranus and Neptune, nor with the rapid revolutions of Mars' satellites, nor with our notions of the rings of Saturn. M. Faye proposes to replace this hypothesis by another one more conformable to existing ideas, taking its point of departure in Descartes' vortices." (*Bull. Astron.*, February, 1885.)

"Prof. G. H. Darwin has contributed to *Nature* (Vol. 31, p. 506) an interesting and valuable criticism of M. Faye's theory of the evolution of the solar system as explained in his paper in the "*Annuaire du Bureau des Longitudes* for 1885, and also in his work entitled "*Sur l'Origine du Monde.*" The best general idea of the line of speculation adopted by M. Faye may be given by saying that it is a theory of evolution from meteorites, instead of from the nebulous matter which gives its name to Laplace's theory. In the primitive condition, the universe consisted of matter scattered in chaotic confusion. Currents were generated in the midst of this chaos under the influence of mutual gravitation; and in consequence of these movements, shreds of matter became detached and moved with rapid linear and slow gyratory motion. The solar system is taken to have originated from a shred which aggregated into a spheroidal shape and consisted, at the epoch when we began to watch it, largely of separate meteorites. It is at first supposed that the spheroidal aggregate consists of matter pretty nearly equally distributed, and later a nucleus is formed. If r be the distance of any point from the center, the force is central and follows the law $ar + \frac{b}{r^2}$ where, in the beginning of the evolutionary process, b is very small, and later a becomes small. Initially, then, when the force is simply as the distance, each meteorite moves in an ellipse about the center, and the periodic time of all is the same, whatever their eccentricity of orbit. In consequence of collisions, a central nucleus is soon formed; as this increases, the a in our formula for the force diminishes and the b increases, but orbits which are circular still retain that form, notwithstanding the progressive change in the law of force. At the same time that the nucleus is being formed, a series of flat and nearly circular rings arise around it, those near to the nucleus attaining a definite shape sooner than the remote ones. It is not adequately explained why the matter should be sifted, and should arrange itself in rings at definite intervals around the nucleus, still less is any light thrown on the law of Titius concerning the distances of the planets from the sun. Considering now the case of the first ring, M. Faye supposes that slight differences of angular velocity, mutual attraction, and collisions gradually cause the aggregation of all the matter in the ring around some center in its line. When the nucleus is small, the rings moved as a rigid whole, and the linear velocity of the outer meteorites was greater than that of the inner ones; therefore when the planetary aggregate is formed, it will be found rotating with direct motion about an axis nearly perpendicular to the plane of its orbit. As we proceed from the first ring outwards, in each successive case the tendency to direct motion is weaker, because the increase of the solar nucleus by absorption of meteorites has prevented so large an excess of linear velocity of the outer meteorites over those of the inner ones as in the first case. By degrees, therefore, we come to planets in which the meteorites move nearly according to Kepler's laws, and here the resulting planet has a retrograde rotation. Each planetary agglomeration in its turn forms a miniature solar system, and generates satellites by the same process as that in which the planets were formed. After having thus sketched M. Faye's theory in its main outlines, Professor Darwin points out that no reference is made to the possible effect of tides in the evolution of the solar system, a part of the subject which has been so ably worked out by Professor Darwin himself. He has shown that the hypothesis that tidal friction has had free play in the past leads to a remarkable quantitative co-ordination of the several elements of the earth's rotation and of the moon's orbital motion, and points to the genesis of the moon close to the present surface of the earth. The rapid orbital motion of the inner satellite of Mars confirms in a remarkable way the truth of the hypothesis. It also throws light on the cause of the observed distribution of satellites in the solar system. It is, in Professor Darwin's opinion, a factor which cannot be left out of account, and has a bearing on theories of evolution which cannot be neglected. Professor Darwin's paper concludes with a summary of the advantages and disadvantages of M. Faye's scheme. The conception of the growth of planetary bodies by the aggregation of meteorites is a good one, and perhaps more probable than the hypothesis that the whole solar system was gaseous. The internal annulation of the meteorites is left unexplained, and this compares very unfavorably with Laplace's system, where the annulation is the very thing explained. The difference of orbital motion of the inner and outer meteorites of a ring, the development of that difference as time progresses, and the consequence of direct and retrograde rotation at different distances from the sun, is an excellent idea. But it is necessary to this idea that the inner planets should have been formed first,* and we are met directly by the fact that the single surviving ring, that of Saturn, is nearer to the planet than are the satellites, and we should be driven to the startling conclusion that Saturn's ring is the oldest feature of his system. The actual distribution of satellites in the solar system is at variance with M. Faye's theory, for as, according to him, the internal planets were generated from rings whose motion was such as would give greater moment of momentum to the planetary agglomeration than would the external ones, the number of satellites should be greater the greater the amount of rotation in the primitive agglomeration of meteorites, and thus the nearer planets should be richer in satellites than the remote ones. On the whole, then, there are great difficulties in the acceptance of M. Faye's scheme, notwithstanding its excellences; but science is undoubtedly the gainer by such suggestive theories." (*Observatory.*)

For further discussion of these interesting questions we must refer the reader to the valuable articles of MM. Radau and Wolf in Volumes I and II of the *Bulletin Astronomique*, and to a paper by Prof. Daniel Kirkwood, read before the American Philosophical Society (November 21, 1884) and published in the April number of the *Sidereal Messenger*. We are glad to learn that M. Wolf intends to elaborate his discussion still further, and that it will be brought out in book form by the publishing house of Gauthier-Villars.

NEBULÆ.

New nebulæ.—M. Stephan has published in the *Astronomische Nachrichten*, No. 2661, positions and descriptions of 100 nebulæ discovered at Marseilles in the years 1883–'85, in addition to the large number previously detected at that observatory. Not the least notable characteristic of M. Stephan's catalogues is the precision of the places given in them. He mentions that on October 1 and 2, 1882, neither the nebula Dreyer-Schultz 5085 nor *h* 12 was visible in the position assigned by the discoverers.

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* In fact, according to M. Faye, the earth is older than the sun. "If it were otherwise, the whole appearance of the sky would be changed; the stars would rise in the west and set in the east; the moon would have a retrograde motion like the satellites of Uranus and Neptune." (*Sur l'Origine du Monde*, p. 192.)

Professor Swift gives in the *Astronomische Nachrichten* two catalogues of nebulæ discovered in 1883–'85 with the 16-inch refractor of the Warner Observatory. Each catalogue contains 100 nebulæ and gives approximate positions for 1885·0, with descriptive notes. All of these nebulæ belong to the fainter classes, and the increased difficulties in dealing with such objects since the appearance of our "red sunsets" have been remarked by Professor Swift, as well as by other observers. Professor Swift has a list of some 150 more nebulæ, which will require further study before publication.

Several shorter lists of nebulæ, found by Tempel, Barnard, and others, generally in the search for comets, will be found in the various astronomical journals.

General catalogue of nebulæ.— Apropos of Dr. Holetschek's letter (*Astron. Nachr.*, No. 2664) concerning the regular publication of supplementary catalogues of new nebulæ, double stars, red stars, &c., Dr. Dreyer announces that he is preparing a second supplement to Sir John Herschel's Catalogue of Nebulæ.

Discovery of a new nebula in the Pleiades by photography.—Probably the most notable achievement in celestial photography during the year has been the discovery by MM. Paul and Prosper Henry, at the Paris Observatory, of a new nebula in the group of the Pleiades. It was first photographed on November 16, 1885, and, though it was again photographed on December 8 and 9, MM. Henry have as yet been unable to detect it by direct telescopic observation. The nebula is about 3′ in extent, and "*très-intense.*" It presents a well-marked spiral form, and seems partially to surround the star Maia.

Professor Pickering writes, under date of January 21, 1886, to the editor of the *Nachrichten* in regard to this interesting discovery, as follows:

"The announcement of this nebula in the *A. N.*, vol. 113, p. 239, recalled the circumstance that certain irregularities had been noticed in a photograph of the Pleiades, taken on November 3, 1885, at the observatory of Harvard College, with an exposure of sixty-five minutes. This photograph was exhibited at the Albany meeting of the National Academy of Sciences, November 10, where the irregularities above mentioned received some attention. They were supposed to be due merely to defects in the photographic process; but upon re-examination it appears that one of them corresponds so closely to what is described by MM. Paul and Prosper Henry that there can be no doubt in regard to its origin. It must represent light photographically perceptible in the vicinity of the star Maia, as stated by its discoverers. - - - The explanation thus afforded of one of the markings on the Cambridge photograph makes the others of more interest than seemed at first to belong to them. There are indications of nebulous light about Merope; four short parallel streaks directly to the south following side are particularly noticeable, and a faint prolongation of diffuse light may be suspected towards the south, in agreement with the descriptions usually given of the visible nebula in that region. There is also a faint narrow streak of light projecting from Electra on the following side. All the bright stars are surrounded by concentric bands, obviously due to effects of reflection from the back of the plate and from the inner surfaces of the lenses. These bands interfere to some extent with the appearances of nebulous light above described, and are most conspicuous around Alcyone, as would be expected from the brightness of that star. No nebulous light is noticeable about Alcyone, Atlas, Pleione, or Taygeta."

Professor Struve announces that he has seen the nebula about Maia very distinctly with the great 30-inch refractor of the Pulkowa Observatory. We learn also from later reports that the nebula has been seen and sketched at the Nice Observatory.

Photographic study of the nebula of Orion.—Prof. E. C. Pickering has made a comparison of the results of photographic and eye observations of this region, comparing the star magnitudes as given by the photographs of Dr. Draper and Mr. Common, with the catalogue of Professor Bond. His results will be found carefully tabulated in the twentieth volume of the *Proceedings of the American Academy.* One of the most important applications of the determination of photographic magnitudes is to the measurement of the colors of the stars. The rays affecting the photographic plate have in general a less wave length than those to which the eye is most sensitive. It therefore follows that a reddish star, that is, one in which the rays of great wave-length predominate, will appear relatively too faint in the photograph. A bluish star is similarly indicated by a large negative residual (on comparison with eye estimates). These residuals form a convenient measure of the colors of the stars; and Professor Pickering gives a list of ten red stars, thus indicated on the plate, varying from 10·7 to 13·9 magnitude, according to Bond, and ten blue stars, varying from 12·3 to 15·6 magnitude. "The faintest stars visible in the photograph have a photographic magnitude of about 15·0."

Variability of a nebula.—"The nebula near the star ζ Tauri seems to present an interesting instance of variability of light. This nebula was observed by Chacornac at Paris on the 19th of October, 1885, surrounding a star of the 11th magnitude, which had repeatedly been observed in 1854, and also at Markree in January, 1850, without any nebulosity being noticed. In January, 1856, Chacornac found this very bright and conspicuous, resembling in its appearance a transparent cloud, reflecting the light of ζ Tauri. But in November, 1862, he could discern no trace of the nebulosity; and D'Arrest also failed to see it when observing the star with the Copenhagen refractor on the 25th of January, 1865. Nor has it since been seen until quite recently, when it was noticed by Mr. K. Tarrant, using a 10-inch 'With' reflector, at Pinner, Middlesex. D'Arrest had noticed a small star of less than the 12th magnitude, a little preceding the 11th magnitude star previously mentioned, and nearly on the same parallel with it. When the nebula was first seen by Mr. Tarrant (on the 14th of March, 1885), it was lengthened in the direction of a circle of declination, and this faint star was at its following edge. The first known instance of this kind was that of the nebula near ε Tauri, discovered by Mr. Hind in 1852, suspected to be variable from not having been seen before, and afterwards proved to be so, becoming invisible even with very powerful telescopes, and subsequently reappearing." (*Athenæum.*)

ASTRONOMICAL CONSTANTS, ETC.

A new determination of the nutation constant.—"Dr. L. de Ball has employed for this determination the right ascensions of three polar stars (α and δ Ursæ Minoris and 51 Cephei), observed at Pulkowa by Herr Wagner, part of which have already been employed by Herr Nyrén in his researches concerning the constant of aberration." (*Bulletin Astron.*, I, p. 202.) Although these observations, which were made between 1861 and 1872, embrace only a little more than half a complete period of nutation, their precision is such as to justify Dr. de Ball's attempt. He has had at his disposal 934 eye-and-ear observations and 933 chronograph observations. The mean error of an observation is nearly the same for the two methods. By introducing as unknown quantities the corrections to the mean right ascensions of the three stars to the nutation constant (Peters) and to the aberration constant (Struve), and also the parallaxes of the stars under consideration, Dr. de Ball has attained the following results:

	″		″
Correction to the nutation constant Δn	−0·006	±	0·012
Correction to the aberration constant Δa	+0·043	±	0·011
Parallax of α Ursæ Minoris	+0·015	±	0·015
Parallax of 51 Cephei	+0·027	±	0·019
Parallax of δ Ursæ Minoris	+0·034	±	0·017

		s		s
R. A. (1865·0) of α Ursæ Minoris (eye and ear)	$1^h\ 9^m$	38·706	±	0·043
R. A. (1865·0) of α Ursa Minoris (chronograph)		39·057	±	0·051
R. A. of 51 Cephei (eye and ear)	$6^h\ 36^m$	11·723	±	0·026
R. A. of 51 Cephei (chronograph)		12·012	±	0·027
R. A. of δ Ursæ Minoris (eye and ear)	$18^h\ 15^m$	53·084	±	0·020
R. A. of δ Ursæ Minoris (chronograph)		53·363	±	0·020

"The six values of the correction Δn furnished by the three stars do not show a very remarkable agreement:

	Eye and ear.	Chronograph.
α Ursæ Minoris	−0″·062	−0″·011
51 Cephei	+0″·028	+0″·003
δ Ursæ Minoris	−0″·016	+0″·039

"The individual values of Δa, computed by Dr. de Ball, differ quite widely in some cases from the values obtained by Herr Nyrén from the same observations, and it seems impossible to discover the cause of these differences. It is without doubt necessary to take into consideration the influence which the motion of the solar system might exert upon the aberration in the case of stars near the pole, as has been shown by Dr. Seeliger." (*Bull. Astron.*, July, 1885.)

The secular nutation of the earth's axis.—"M. Folie, having deduced a periodic formula for the secular variations in obliquity and in longitude, applies the designation 'secular nutation of the earth's axis' to these variations. Defining the normal equator as a plane, the inclination of which to the ecliptic of a certain epoch is equal to the mean obliquity of that epoch, and the intersection of which with this latter plane passes at each instant through the mean equinox of that instant, he concludes that, in virtue of the secular nutation of the earth's axis, the mean pole describes around the normal pole, considered as fixed, an ellipse the major axis of which, directed towards the pole of the fixed ecliptic (*i. e*, the mean ecliptic of the epoch), is sensible during several centuries. The period of the secular nutation is about 30,000 years, differing little from that of the precession on account of the slow motion of the node of the ecliptic, which is only $8''\cdot 7$ per annum. Assuming a uniform value of $50''$ for the secular diminution of the obliquity, M. Folie compares the results obtained from his formula with ancient observations of the obliquity, and is thus led to announce that the empirical expression $\varepsilon_1 = 0''\cdot 476 + 0''\cdot 000018t$ for the annual diminution (where t is the number of years from 1850) satisfies very closely the observations from -250 to $+1487$. This expression, however, gives a considerably greater variation to the secular diminution of the obliquity than that which results from Leverrier's researches." (*Nature.*)

Precession tables.—In the *Monthly Notices* for December there will be found tables by Mr. Rambaut for the reduction of Bessel's precessions to those of Struve.

Astronomical refraction.—M. Lœwy has recently communicated to the *Académie des Sciences* an account of a method which he considers to be especially adapted for determining the constant and other elements of refraction. The principle of the method is this: A glass prism with silvered faces, forming a double mirror, is placed in front of the object glass of an equatorial. By means of this arrangement the images of two stars which are widely separated in the sky can be brought close together in the focal plane of the telescope; thus one star may be at the zenith and the other on the horizon, in which case the measured distance between the images will be largely affected by refraction. After an interval of three or four hours, when the stars are at an equal height above the horizon, and when, therefore, the effect of refraction is a minimum, the distance between the images is again measured. The comparison of these two observations gives the means of determining the amount of the refraction with great accuracy. It is of course necessary for the success of the method that the measures should be absolutely independent of every possible displacement of the apparatus in the interval between the observations. This result is obtained by placing the double mirror in such a position that the planes of reflection for the two stars coincide, as M. Lœwy finds that under these circumstances, whatever small displacements the mirror may undergo, the distance between the images in the field of the telescope, measured in the plane of reflection, or the projection of this distance on the trace of the plane of reflection in the field, remains invariable. M. Lœwy claims for this method that, on account of its simplicity and the ease with which it can be put in practice, it completely solves the problem to which he applies it. A few experiments ought to show whether it is capable of affording results sufficiently accurate to make the method of practical value. (*Observatory.*)

STAR CATALOGUES, ETC.

Glasgow catalogue.—"The Glasgow Catalogue,* recently published by Mr. Robert Grant, is the subject of a very detailed review by Dr. Auwers in the *Vierteljahrsschrift* for 1884. The catalogue depends upon observations made since 1860 by the Ertel meridian circle, and comprehends, besides some hundreds of bright stars selected from the B. A. C., more than 6,000 telescopic stars from Weisse's first catalogue. The stability of the instrument has been satisfactory, although not comparable with that of the Greenwich circle. The process of reduction employed by Mr. Grant is not entirely beyond criticism. Dr. Auwers has undertaken a minute comparison of this catalogue with that of the *Astronomische Gesellschaft* in order to determine the relative precision of Mr. Grant's positions. He finds the mean error of these positions to be ± $0^{s}\cdot06$ and ± $0''\cdot9$ for the unit of weight (which depends upon the number of observations). This mean error being $0^{s}\cdot04$ and $0''\cdot6$ for the best catalogues, Dr. Auwers thinks the relative weight, one-half, may be attributed to the Glasgow positions." (*Bull. Astron.*, March, 1885.)

Cordoba Zone catalogue.—"In a notice in the *Observatory* for January, 1885, devoted to Dr. Gould's zones, Mr. Downing shows the high value of this great work, which it has required no less than thirteen years to bring to completion. We already owe to Dr. Gould the *Uranometria Argentina*, which the Royal Astronomical Society honored in 1883 with its gold medal. The publication of a general catalogue is looked for soon, and this, with the catalogues of the Cape and Melbourne, will measure the extent of our knowledge of the southern heavens.

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[*] Catalogue of 6,415 stars for the epoch 1870, &c., by Robert Grant. Glasgow, 1883. 4to.

"The zone observations were commenced in 1872. The total number of observations is more than 105,000 for 73,160 stars, between —23° and —80° of declination, the lowest magnitude being the 10th. The Repsold meridian circle is reversible; the objective has an aperture of 122^{mm}, and a focal length of $1^{m}{\cdot}463$; the divided circle has a diameter of $0^{m}{\cdot}716$, and the readings were made by means of four microscopes. In the zone observations it was the rule to observe the transits over three threads, and to read but one microscope. The right ascensions depend upon the positions of Dr. Gould's fundamental stars, published by the Coast Survey, and nadir observations have been made concurrently with observations of polar distance. The mean error in right ascension is $0^{s}{\cdot}062$, and in declination $0''{\cdot}97$. The observations were made under the best conditions, and no pains have been spared in determining accurately the instrumental errors and in verifying the reductions." (*Bull. Astron.*, February, 1885.)

The stereotype plates of this catalogue have been placed in the custody of the *Astronomische Gesellschaft.* We make the following extract from a letter of Dr. Gould's in regard to the matter: "The recently published catalogue, formed from the Cordoba Zones, was printed from stereotype plates, in order that any errors discovered up to the last moment might be corrected before the work should be actually printed. The plan has proved successful, and I believe the catalogue to be more than usually correct; nevertheless, a considerable number of errors have been detected since it was printed, and a list of these will soon be sent to the *Astronomische Nachrichten.* I have now been charged by the Argentine Government with the agreeable duty of causing the recently detected errors to be corrected upon the stereotype plates, and offering these to the *Astronomische Gesellschaft,* for its acceptance, in case the gift should not be considered too burdensome. - - - It is of course understood that the gift of the plates carries with it the fullest authority for the *Astronomische Gesellschaft* to use them for printing a new edition whenever it may see fit."

Catalogue of 1,001 *southern stars.*—Volume 3 of the Publications of the Washburn Observatory contains a catalogue of 1,001 stars between 18° and 29° 39′ of south declination, formed by Rev. Father Hagen and Professor Holden from a series of 2,161 observations made by Professor Tacchini with the Pistor and Martins meridian circle at Palermo in the years 1867, 1868, 1869. The observations were originally published in the *Bullettino Meteorologico del R. Osservatorio di Palermo* from April, 1867, to July, 1869, where the apparent place and epoch are given, and Professor Holden says that the existence of this valuable material became known to him through the admirable *Vade-Mecum* of M. Houzeau. The stars observed are from the 6th to the 9th magnitude, and the magnitudes appear to have been very carefully noted, while it is remarked that the positions are excellent. They are reduced to the year 1850·0, but the mean epoch of observation of each star is appended.

Professor Holden and Father Hagen have also derived the places of 437 southern stars for 1850.0 from Washington transit-circle observations, and these places have been compared with positions given in the Cape Catalogue for 1880, the Cordoba Zones, and Yarnall's Catalogue. The comparisons are printed in the volume referred to above, and will be of value in deducing the relations of the various systems adopted.

*The "anonymous" stars of Yarnall's Catalogue.**—"Prof. E. Millosevich has published a useful contribution to exact astronomy in his paper, *Sulle Stelle boreali fino a* —1° *inclusivo dette 'Anonymous' del Catalogo di Yarnall* (Washington, 1878). It appears that between the limits +90° and —1° declination, Yarnall's Catalogue contains 732 stars which are designated as anonymous. Professor Millosevich has carefully gone through these, comparing them with the DM., or with the catalogues of Weisse, Rümker, Struve, Lalande, or Oeltzen's Argelander, and has succeeded in almost every case (sometimes by making conjectural corrections to Yarnall's places) in identifying the star in the Washington Catalogue. The paper also contains a comparison of the estimates of magnitude made by the Washington observers and by Argelander in the case of these anonymous stars. After applying a systematic correction of +0·3 of a magnitude to Yarnall, Professor Millosevich finds that there are 33 stars which differ by 0·9 of a magnitude or more in the two catalogues, and gives a list of these with their places for 1860·0, as there is a strong presumption that they will prove to be variables. Taken in conjunction with Holden's List of Errata in Yarnall (*Astron. Nachr.*, No. 2561), Professor Millosevich's paper is a useful addendum to the Washington Catalogue for 1860." (*Observatory.*)

Professor Frisby, of the Naval Observatory, is now at work upon a third edition of *Yarnall's Catalogue*, in which it is intended to correct all the errors thus far detected.

Harvard College catalogue of 1,213 *stars for* 1875.—"This catalogue contains the results of observations made during the years 1870 to 1879 with the meridian circle of the Harvard College Observatory, the stars observed being chiefly those required for the revision of the *Durchmusterung* for the zone between the parallels of declination +50° and +55°. The star places employed as points of reference were taken from the list given in Publication XIV of the *Astron. Gesellschaft.* The right ascensions and declinations published in the catalogue are derived from a discussion of the results obtained during the whole period covered by the observations. They are given in their present form for the purpose of making them immediately available in advance of the publication of the volume which is to furnish the details of the investigation, viz, volume XV of the *Annals.* The observations were nearly all made by Professor Rogers, who has also had charge of their reduction and publication,—a statement which is a sufficient guarantee for the accuracy of the observations, and for the thoroughness of the reductions." (*Observatory.*)

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* *Annali della Meteorologia Italiana,* Part iii (1884).

Cape observations.—Dr. Gill has published, in one volume, the Cape Meridian Observations 1879–'81. During these years the Cape transit circle was employed in observing, in conjunction with Leyden, a list of fundamental stars required in the meridian observation of the stars between declination —1° and —20°, contained in Schönfeld's extension of the *Durchmusterung.* In addition to these, two further lists of stars were observed, one of which had large Z. D. at the Cape and small Z. D. at Leyden, the stars of the other list culminating near the zenith of the Cape and at small altitudes at Leyden. There were also observed during these years stars which were employed in the longitude operations connecting Aden and the Cape. (*Observatory.*)

Cape catalogue for 1850.—Dr. Gill has also recently published (no date of publication) a catalogue of 4,810 stars, the results of observations made at the Royal Observatory, Cape of Good Hope, from 1849 to 1852, under the direction of Sir Thomas Maclear. The right ascensions were observed with Dollond's transit, which was mounted in 1828, immediately after the erection of the observatory buildings. The north polar distance observations were made with the mural circle, which was mounted in 1829. "No proper motions are given in the catalogue, and none have been applied to the star places. The catalogue therefore represents the places of the stars at the epoch of observation, but reduced to the equinox 1850·0." For the purpose of determining systematic errors a comparison is given with the Cape catalogue for 1880, the separate results being given in a column marked "Cape 1880, *minus* Cape 1850."

Fundamental stars.—At the meeting of the Royal Astronomical Society on March 13, 1885, "Mr. Downing read a paper on the star places given in the *Nautical Almanac.* The star places in the *Nautical Almanac* for 1884 were derived from the *Nine-Year Catalogue,* while in 1883 and preceding years the *Seven-Year Catalogue* was employed. Mr. Downing has deduced the systematic discordances resulting from the change of catalogues. In considering the R. A.'s he found for 24 stars discordances greater than $0^s{\cdot}05$, their mean discordance being $0^s{\cdot}064$, which seems to indicate inaccuracies in the proper motions employed. If Dr. Auwers's results for these stars' proper motions are substituted for those of Main and Stone, the mean discordance is reduced to $0^s{\cdot}042$. It seems, then, desirable to adopt the proper motions that are the result of Dr. Auwers's researches. In one of the last volumes of the *Berliner Jahrbuch,* Dr. Auwers has made a comparative study of the positions of fundamental stars contained in the principal ephemerides, in particular the *Nautical Almanac.* He shows in this article that a sufficiently accurate allowance for the proper motions has not always been made.

"Mr. Downing read a second paper upon the R. A.'s of the Cape catalogues of 1850 and 1880. He has compared the R. A.'s of the catalogue of 1850 with those of the catalogue of 1840, those of the catalogue of 1880 with the Melbourne catalogue for 1870, and with the Cape catalogue for 1860. The results of the Cape for 1850 and 1880 have thus been referred to the mean of three other catalogues (Melbourne, 1870; Cape, 1840 and 1860). Mr. Downing's conclusion is that the discordances between the two Cape catalogues for 1850 and 1880 should not be laid to the account of the latter catalogue. There is an error of $0^{s}\cdot1$ at 140° polar distance." (*Bull. Astron.*, May, 1885.)

New methods of determining the co-ordinates of polars without the necessity of knowing the instrumental constants.—According to the usual method the instrumental constants are determined by supposing the co-ordinates of one or two polars to be known; these co-ordinates are corrected from time to time by the combination of all the available pairs of observations separated from each other by twelve hours; these pairs of observations are, however, rather rare. If the star observed is situated very near the pole, the circle that it describes in its diurnal motion will be entirely comprised within the field of the telescope, and evidently observations of the star's position, separated by four hours, for example, may take the place of those separated by twelve hours.

M. Lœwy gives formulæ, by whose aid two observations separated by an interval of four hours may be taken, and certain geometrical conditions indicated by his theory being complied with the whole effect of the instrumental errors may be eliminated. The co-ordinates of polars may be thus determined with a high degree of precision and quite independently of the level, azimuth, and collimation errors, as well as of the flexure and division errors.. (*Bull. Astron.*, August, 1885.)

Inaccuracies due to the use of the usual formulæ in the reduction of polar stars. A method of observing polars at any distance from the meridian.—"It is sometimes convenient to observe circumpolar stars when off the meridian; the ordinary reduction may then lead to erroneous results. M. Lœwy introduces a simple corrective term, by employing which the desired accuracy may be attained; the computation is facilitated by a numerical table annexed to the memoir." (*Bull. Astron.*, April, 1885.)

Star-charts.—In the *Vierteljahrsschrift* for 1884 Herr Palisa, in speaking of the publication of Dr. C. H. F. Peters's celestial charts, enters into some interesting details concerning the different processes employed in the construction of charts to be used in searching for minor planets. He speaks briefly of the very appreciable differences between Dr. Peters's estimates of magnitude and those of other observers when the stars under consideration are below the tenth magnitude. Thus Dr. Peters's eleventh magnitude stars are called twelfth and thirteenth magnitude by Herr Palisa. Herr Palisa made his estimates with a 12-inch telescope, Dr. Peters with a 13.5-inch. Herr Palisa adds that, after having used a 6-inch telescope at Pola for a long time, he found himself quite unable to estimate magnitudes with his 12-inch for as much as a year after beginning to use it, the differences of intensity between the tenth and thirteenth magnitudes seeming much less sensible than with the 6-inch. Dr. Peters's twenty charts that are already published are remarkably accurate, according to the careful revision of them made by Herr Palisa. (*Bull. Astron.*, March, 1885.)

Scintillation of stars.—The instrument employed daily by M. Montigny consists of a telescope of $0^{m} \cdot 077$ aperture, which contains, in front of the focus, a circular piece of glass, capable of being turned more or less rapidly about an axis parallel to the optical axis of the telescope; the glass plate, when slightly inclined toward the optical axis, causes the luminous rays to deviate laterally, and when it is very rapidly revolved a luminous circumference appears interrupted by colored arcs, which correspond to the changes of color. The number of these arcs, which is determined by means of a micrometer especially adapted for the purpose, in which are two cross-threads comprising an aliquot part of the circumference, divided by the number of revolutions made by the plate in one second, gives the number of changes per second of the star's color.

Dufour seems to have been the first to make a regular series of observations of the changes of color in stars. Without any especial instrument, simply comparing the stars among themselves (as is often done for variable stars) Dufour came to the following conclusions:

(1) Red stars scintillate less than white stars.

(2) Excepting near the horizon the scintillation is proportional to the product obtained by multiplying the thickness of the air traversed by the luminous ray by the astronomical refraction of the altitude under consideration.

(3) Aside from the influence of color there are essential differences in the scintillation of different stars, which seem to depend upon the stars themselves.

The second law is important, as it permits of reducing all observations to the same zenith distance (the angle of 60° has been adopted).

M. Montigny has confirmed the results of the Swiss investigator by means of his scintillometer, and has further shown on what the scintillation of stars may depend. According to the work of Secchi, Huggins, and Miller, the stars are arranged in two great classes: White or blue stars, like Sirius, whose spectra show, in particular, hydrogen bands; yellow stars, like the sun, with spectra containing numerous fine lines (magnesium, sodium, &c.). In grouping his observations M. Montigny affirms that both for Dufour and himself:

"The stars whose spectra are characterized by dark bands and black lines scintillate less than stars whose spectra are composed of numerous fine lines and much less than those whose spectra present some principal rays."

Collecting his observations, M. Montigny has formed a *Catalogue de Scintillation des principales Étoiles* of the northern heavens.

The most original part of M Montigny's researches concerns the influence of the state of the atmosphere, of terrestrial magnetism, and of auroræ upon scintillation. Without entering into details, we would speak of the fact that the author has taken note of some of the characteristics of the luminous curve of the scintillometer; besides the intensity already defined, he now observes the aspect of the circular area, which appears sometimes regular (in clear weather), sometimes diffuse, curved or broken (during a rain); he also observes the different colors seen in the scintillometer, which are quite bright with a clear sky. M. Montigny's article closes as follows:

"That which exercises the most marked influence upon scintillation and most modifies its characteristics is the presence in the atmosphere of a greater or less quantity of water, whether disseminated in the form of vapor or falling in the form of rain or snow."

M. Montigny is of the opinion that the continued study of scintillation will furnish useful data for weather predictions. (*Bull. Astron.*, August, 1885.)

STELLAR PARALLAX.

Heliometer determinations of stellar parallax in the southern hemisphere, by David Gill and W. L. Elkin (*Mem. R. A. S.*, Vol. 48, Part I, 194 *pages*).—The heliometer has an aperture of 4 inches, and is fully described in the Dun Echt Publications, vol. II. The only modification made by Dr. Gill to this instrument,—which he had already employed in 1874 at Mauritius, at the time of the opposition of Juno, and in 1877 on his expedition to Ascension Island at the time of the opposition of Mars,—was in the rotation of the tube in its cradle.

The plan adopted may be explained in a few words. To refer the star that is being investigated to neighboring stars situated symmetrically with reference to the first star, near the major axis of the parallactic ellipse and differing little in magnitude; to reduce the brightness of the star to be investigated sufficiently for its image to be comparable with those of the comparison stars, by means of wire screens; finally, to substitute differential measures for absolute ones, grouping the successive observations in such a way as to obtain the distances of the principal star from the two other stars at the same instant, and consequently so as to obtain the relation of the difference of the distances to their sum without bringing in the absolute value of the scale.

It seems probable that systematic errors will be thus almost entirely avoided, especially if several observers combine their results. Let us consider the operations in detail, taking α Centauri as an example.

There was an unusual difficulty in this case, α Centauri being a double star. The screen employed reduced α_2 to the magnitude $8\frac{1}{4}$, and rendered it impossible to distinguish α_1, but at the same time the measures of distances from stars fainter than 7·5 magnitude could not be so well made with a 4-inch heliometer. However, the 16 measures forming a *complete observation* are always made as follows: Each distance is measured twice for the sake of eliminating the constant error of the index, commencing with one of the stars, say α, then passing to β, turning the tube 180° in its cradle, taking β again and then α to complete the series. The sum and difference of the distances of α_2 Centauri from the first pair of stars chosen by Mr. Gill have the following parallactic factors:

$$\alpha + \beta,\ 0{\cdot}011\ \mathrm{R}\cos(\Theta - 96^\circ{\cdot}0),$$
$$\alpha - \beta,\ 1{\cdot}881\ \mathrm{R}\cos(\Theta - 347^\circ{\cdot}3);$$

R and Θ indicating the radius vector and the sun's longitude; the maxima and minima of the parallax for $\alpha - \beta$ occur upon March 7 and September 10.

We may pass over all that refers to the various corrections, the errors of the screw, refraction, the proper motion of α Centauri and aberration; it will suffice to say that in adopting for the sum of the distances a mean value derived from all the observations, the distances and their differences were reduced to a normal scale, and the only question now is whether these differences are not affected by systematic errors inherent in the observer. It might be, for example, that the observer would insensibly change his method of proceeding, thus introducing a term proportional to the time, but the personal error might also depend upon the hour angle if one observed to the east or to the west of the meridian, and at a greater or less distance from it, and in passing from one position to another a discontinuity might occur.* Mr. Gill used a reversing prism for Mars in 1877 for the sake of eliminating this last cause of error,† and he regrets not having continued its use, and avoiding thus, as he says, so much labor. The observations commenced July 5, 1881, and were continued regularly until April, 1882, when the existence of a systematic error depending upon the hour angle became evident. After this the conditions under which the observations were made were carefully noted, and it was possible to recall the conditions of the greater part of the preceding observations.

There are four series of observations for α Centauri—two by Mr. Gill, and two by Mr. Elkin—with four pairs of comparison stars. One of the first facts to be proved is the impossibility of treating the observations of each series as a whole. Mr Gill's diagrams prove this, as do also Mr. Elkin's numbers (giving his observations equal weights, Mr. Elkin found from his two series the values 0″·65 and 0″·55 instead of 0″·75). It seems best, then, to represent the influence of the systematic error by a trigonometric series depending upon the angle formed by the direction of the measures with the vertical, or more simply to admit for each position of the eye a constant error, varying slightly with the hour angle. Mr. Elkin proceeds thus, and his idea seems very rational. It is possible that Mr. Gill's second series of observations might be represented in the same way without introducing any hypothesis concerning the orbital motion of α Centauri.

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* It is known that observations of the nadir and measures of the declination of a star when between two threads are influenced by the position of the observer.

† Dr. Seeliger has also recently recommended the use of such a prism (*Bull. Astron.*, I, p. 450). We believe that one has been employed at the observatory of Leyden for a long time.

After having given an idea of the delicate questions which Mr. Gill and Mr. Elkin have had to solve, it remains to present the results obtained:

Star.	Observer.	Parallax.	Probable error.	Mag. of comp. stars.
		″	″	
α Centauri	Gill and Elkin	+0·75	±0·01	7·6
Sirius	do	+0·38	0·01	7·5
ε Indi	do	+0·22	0·03	7¼
Lacaille 9352	Gill	+0·28	0·02	7·6
o^2 Eridani	do	+0·166	0·018	6·4
β Centauri	do	−0·018	0·019	7
ζ Toucanæ	Elkin	+0·06	0·019	7½
e Eridani	do	+0·14	0·020	6·4
Canopus	do	+0·03	0·030	8

It is known that the observatory at the Cape will possess in two years from now a 7-inch heliometer, while Mr. Elkin has at his disposal, at Yale College, the most beautiful heliometer known to-day (6 inches aperture). It is quite possible that within ten years stellar astronomy may be enriched by discoveries of the greatest value. (O. Callandreau, in *Bull. Astron.*, January, 1885.)

Parallax of 40 o^2 *Eridani.*—Professor Hall publishes in No. 2682 of the *Astronomische Nachrichten* the results of observations made in 1883 and 1884 to determine the annual parallax of the star 40 o^2 Eridani. The principal star of this system has a proper motion of 4″ a year; and, at a distance of 82″, there is a double companion, which has the same proper motion, while nearly between them is a small star which does not move. Professor Hall finds for the parallax of 40 Eridani, $\pi =$ 0″·223±0″·0208, a result rather smaller than might have been expected, but one which he considers worthy of considerable confidence.

Parallax of Σ *2398* (*P. M.* 2164).—Dr. Lamp, of Kiel, has investigated* the annual parallax of this double star, the components of which are 8·2 and 8·7 magnitude, according to W. Struve, and for the epoch 1832·17, distance 12″·420, and position-angle 134°·37. Later measures by Mädler, Dembowski, and Engelmann show a change of relative position, but of such small amount as to defeat any attempt at the determination of an orbit. The stars have a common proper motion of about $-0^s\cdot1726$ in right ascension and $+1''\cdot8955$ in declination, and this peculiarity led to the suspicion of a measurable parallax. The comparison stars used by Dr. Lamp were DM. +59°, 1913, and 1919, of 9·4 and 7·8 magnitude, respectively, and the mean result obtained is

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* *Astron. Nachr.*, 2676.

$$\pi = 0''\cdot34 \pm 0''\cdot034$$

The position for 1885 is R. A. = $18^h41^m\cdot5$; Decl. = + 59° 27′.

DOUBLE STARS.

The orbit of 61 *Cygni.*—Prof. C. F. W. Peters, of Kiel, has published in Nos. 2708–9 of the *Astronomische Nachrichten* an elaborate determination of the orbit of the double star 61 Cygni. This, as he remarks, had not hitherto been satisfactorily accomplished, although very numerous observations have been made, extending over an interval of more than one hundred and thirty years, principally on account of the peculiarity that the apparent path of the companion star is very nearly rectilinear in direction and uniform in amount, seeming to indicate that the apparent motion of the double star is common to both components, and that there is no perceptible motion of one with reference to the other. - - - The most recent investigation is that of Prof. O. Struve, published in the twenty-seventh volume of the *Memoirs of the Imperial Academy of St. Petersburg*, in 1880, which, founded on the observations (carefully cleared from systematic errors) made at Dorpat and Pulkowa in the fifty years from 1828 to 1878, represented them by a circular orbit. This, however, proceeded, as Professor Peters points out, on the inadmissible assumption that the angular velocity of the star, with regard to the center of the circle, was uniform. Before commencing the present investigation, he reduced all the available observations to a common epoch (the beginning of 1850). It soon appeared that it was not possible, on account of the very small curvature of the path, to obtain an elliptic orbit by the application of the ordinary methods. Professor Peters therefore determined in the first place the circular orbit which should best represent the observations, and proceeded afterwards to deduce an elliptical one. The eccentricity of this ellipse is 0·17, corresponding to an eccentric angle of 10°, and the semi-major axis 29″·48. The period of the companion star in the elliptic orbit thus calculated amounts to 782·6 years. If the path be accepted as thus calculated by Professor Peters, it becomes possible to determine an approximate value of the sum of the masses of the components. This he finds to be 0·826 or 0·266, in terms of the sun's mass according as 0″·37 or 0″·54 be taken as the parallax of the star. As a mean, therefore, the sum of the masses would be equal to about half the mass of the sun, whilst the mean distance of the two stars from each other would be about seventy times that of the earth, or two and one-third times that of Neptune, from the sun. It is not possible as yet to draw any conclusion with regard to the distribution of the whole mass between the components, or of the position of the center of gravity of the system. Peters has computed from his elements the following ephemeris:

Epoch	1885·0	1886·0	1887·0	1888·0
Position	119° 44′	120° 7′	120° 31′	120° 55′
Distance.............	20″·60	20″·71	20″·81	20″·92

Double-star measures.—Nos. 2662–63 and 2677–78 of the *Astronomische Nachrichten* contain a series of measures of double stars made by Herr R. Engelmann during the years 1882–'84, preceded by a comparison of the differences between the observer's positions and distances of a number of stars, with those measured by Dembowski and Asaph Hall, and by other particulars bearing upon his own results. For several of the more interesting binaries the following epochs are given:

		°	″
Castor..	1882·88	234·3	5·56
ζ Cancri..	1884·28	67·0	0·94
ω Leonis	1884·23	91·4	0·66
ξ Ursæ Majoris	1884·41	249·6	1·92
γ Virginis	1883·07	155·6	5·22
42 Comæ Berenices	1882·93	192·1	0·56
ξ Bootis	1884·45	266·6	3·65

Another important series of double-star measures will be found in *Astronomische Nachrichten*, 2684–85. They are communicated by M. Perrotin, of the Nice Observatory, and are in continuation of the observations published in Nos. 2529 and 2559–60.

The series of micrometrical measures of double stars made at the Temple Observatory, Rugby, is continued in a "Fourth catalogue," published in volume 48 of the Memoirs of the Royal Astronomical Society.

A cause of systematic errors in measures of double stars.—M. Bigourdan (*Bull. Astron.*, I, 439) has recently pointed out a possible cause of systematic error in observing position angles. In the case of the Secretan equatorial of $0^{m}·305$ aperture of the Paris Observatory, he finds that the diffraction-rings surrounding the images of the brighter stars are discontinuous; so that when the objective is turned through 180° round its optical axis, as in observing east and west of the meridian, there is sufficient difference in the relative appearance of the components of a double star to cause systematic errors in the observed position-angles. And, in fact, from a series of experiments which M. Bigourdan has carried out with this instrument, he finds that there are considerable differences in the position-angles measured under the same conditions by the same observer, and within a few minutes of each other; so that the line joining the stars makes much the same angle with the line joining the eyes (always horizontal) in the two cases, one being east of the pier and the other west. M. Bigourdan points out that the errors cannot be eliminated by determination of personal errors from observations of artificial stars, since in these latter measures the stars alone are moved, and not the objective. It would be desirable, then, for observers who possess telescopes mounted in what is generally known as the "German" manner, and having such a defect as is described by M. Bigourdan, to have the tube of the telescope made movable round its optical axis, and to form each measure of position-angle from the mean of six made in six positions of the objective differing by 60°. As this would be practically impossible in the case of large instruments, M. Bigourdan suggests that observers, commencing a series of observations of double stars with telescopes of any considerable size, should turn the objective through 60° at the commencement of each year and re-measure the same pairs as in the preceding year, and to continue this process until each pair has been measured in the six positions of the objective. (*Observatory*, March, 1885.)

Procyon.—In the *Vierteljahrsschrift* for 1884, Herr Seeliger reviews a work on *Procyon* by L. Struve. The work is a discussion of two series of observations of Procyon made at Pulkowa since 1851, and has apappeared in the Memoirs of the Academy of Sciences at St. Petersburg. It is hard to tell whether these observations confirm Dr. Auwers' result (a circular orbit with a radius of $1''{\cdot}00$); they appear, on the whole, to indicate motions of a smaller amplitude.

β Cygni, Albireo.—The December number of *L'Astronomie* contains an article on this star in which a singular mistake occurs. β Cygni is Flamsteed's 6 Cygni, and M. Flammarion has been misled by this circumstance into identifying it with Bode's 6 Cygni, which latter star Professor Ball observed for annual parallax a year or two back, and found for it a value of about half a second. The star observed by Professor Ball is called 6 (B) Cygni, as being the second of the pair, 6 Cygni being a double star. (*Observatory.*)

VARIABLE, NEW, OR TEMPORARY STARS.

*Gore's catalogue of suspected variables.**—This catalogue may be regarded as complemental to the *Catalogue of Known Variable Stars*, by the same author, which was read before the Royal Irish Academy, January 28, 1884. It contains a list, including lettered numbers, of 745 stars in which some change of magnitude is suspected. The stars are tabulated in order of Right Ascension for the epoch 1880·0, and in separate columns are to be found particulars of the supposed change of magnitude and the authority on which the supposed change rests. In the notes and observations, by which the catalogue is followed, are given particulars of the history of each star, together with observations by the author of such stars as have received attention from him. The work is accompanied by a map showing the distribution of known and suspected variable stars.

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* A Catalogue of Suspected Variable Stars, with Notes and Observations. By J. E. Gore, M. R. I. A., F. R. A. S. A paper read befote the Royal Irish Academy, May 12, 1884.

A catalogue of this character forms a valuable working catalogue for the observer's use. By further observation suspected variation will in some cases be proved to be real, and the stars claim a place in a catalogue of known variables. A claim of this kind might indeed already be made in the case of Nos. 234, 455, and 635 of Mr. Gore's list. It may just be mentioned in passing that the place of No. 234, U Canis Minoris is incompletely given in the catalogue. Its more exact place for 1880 is R. A. $7^h 34^m 49^s$; Decl., $+8° 39'·5$. There are other cases in which, though the period is as yet indeterminate, the fact of variation and its amount may be stated with some confidence. On the other hand, further observation may tend to throw a doubt on the suspicion of change in the case of other stars, and, as our author observes, "these must of course be removed from future catalogues." In the notes to No. 287, of his catalogue, *α* Hydræ, Mr. Gore quotes remarks by Sir John Herschel, Dr. Schmidt, and Dr. Gould to the effect that the supposed variability of this star may possibly be due to the influence of its ruddy color on the estimates of its brightness. Is it not possible that the effect of color on estimates of magnitude as respects different observers, or the same observer at different times, has hardly received so much attention as it deserves?

Large as is the number of stars included in Mr. Gore's catalogue, further additions might be made to it. Comparing it, for instance, with the tables of suspected variables, extracted from Mr. Chandler's unpublished catalogue, by Professor Pickering, and printed in his "Recent observations of variable stars" in the *Proceedings of the American Academy*, we find some thirty stars which are not included in Mr. Gore's list, and it is probable that others might be found in other quarters also. Indeed, the experience of most variable-star observers would probably suggest the view that cases of slight but distinctly recognizable light variation are relatively numerous.

A word in regard to No. 445 in the catalogue may possibly help to avert the chance of a little confusion in the future. This star was entered as U Bootis in Professor Schönfield's first catalogue of variable stars, but was rejected by him in his *Zweiter Catalog.* There is another star called U Bootis by Mr. Baxendell, in a paper in the *Manchester Lit. and Phil. Soc. Proceedings*, vol. 21, No. 11, the place of which, brought up to 1880, is R. A. $14^h 48^m 47^s$; Decl. $+18° 10'·9$. This star has a period of 175·5 days, with a range of magnitude from about 13·5 at minimum to about 9·2 at maximum.

In conclusion we commend to the attention of all who are interested in the subject of variable stars a work the preparation of which must have entailed on the author a considerable amount of labor both as compiler and observer. (*Nature.*)

New variable in Vulpecula.—Mr. Edwin F. Sawyer has found* that the star D M. + 27°, 3890 is an interesting variable of the η Aquilæ type. From a preliminary reduction of the few observations thus far obtained a light curve has been formed, indicating strongly that the period will not vary much from 4½ days. The approximate limits of fluctuation are from 5·5 to 6·7 mag. The star is not in Argelander's *Uranometria Nova;* in *Heis* it is 6·0; in *Harvard Photometry* and the *Durchmusterung* 6·1. It is close to the star 32 Vulpeculæ, which has been suspected of variability. The position of the new variable for 1885·0 is: R. A. $20^h\ 45^m\ 19^s{\cdot}4$; Decl. + 27° 42′·3.

New variable in Cetus.—Mr. Sawyer also reports† a new variable in the constellation Cetus. The star was first observed on December 16, 1884, and noted as 7th magnitude. On January 10, 1885, it had decreased about a magnitude in brightness, and by February 10 it was barely visible in a field-glass, or it was of about 9·0 magnitude. An observation on March 5, by Mr. Sawyer and Mr. Chandler, with a 6-inch equatorial, made the star of 10½ magnitude. The position for 1855·0 is: R. A. $2^h\ 26^m\ 45^s$; Decl. — 13° 47′, and the star appears to be identical with S. DM. — 13°, 479. (*Astron Nachr.*, 2691.)

Variability of D M.—1°, 3553.—Dr. Valentiner, director of the Karlsruhe Observatory, has detected a slight variation, of about 0·5 magnitude, in the brightness of this star.

Variable in Ursa Minor.—Dr. Safarik has carefully observed a star given in Professor Pickering's second list of stars with remarkable spectra and there noted as variable; and he has found a mean period of 337 days with the epoch of max. 1883 August 1, epoch of min. 1883 November 26. The star is red, and gives a banded spectrum. Professor Safarik has designated it "R Ursæ Minoris," as the first variable known to him in the constellation Ursa Minor.

Observations of variable stars in 1884.—In the *Proc. Amer. Acad.*, vol. xx, p. 393, Professor Pickering gives a concise but clear view of the progress of observations, in Europe as well as in America, of this interesting class of objects during the year 1884. The following observers have co-operated with Harvard College in this important branch of astronomical research, viz, Backhouse and Knott in England; Dunér, Hartwig, Safarik, and Wilsing on the continent of Europe; Eadie, Hagen, Parkhurst, and Sawyer in the United States. Professor Pickering gives a list of about 150 variables which have been observed during the year, with the number of nights on which each star was observed by the astronomer whose designation is attached to the number. It is hoped that observers of variable stars will continue to furnish accounts of their work during each year as soon as possible after its close. It is desirable that these accounts should be received at the Harvard College Observatory as early as February 1 of the following year. (*Observatory.*)

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* *Astron. Nachr.*, 2704.

† *Astron. Nachr.*, 2660.

The new star in the great nebula of Andromeda.—The astronomical event that attracted the most widespread attention in the year 1885, or perhaps in several years, was the telegraphic announcement, on August 31, by Dr. Hartwig, of the Dorpat Observatory, of his discovery, on the previous evening, of a new star in the great nebula of Andromeda.

The following account of this "*Nova* Andromedæ" is taken from a paper *read by Prof. Asaph Hall, at the meeting of the Philosophical Society of Washington, on February 13, 1886. Further details of the observations must be deferred to another report.

Dr. Hartwig "had suspected some change in the nebula as early as the 20th of August, but bad weather and a lack of instrumental means for making the matter certain deferred the announcement until the 31st. From the various estimates at that time the star was probably a little brighter than the 7th magnitude, or just below the limit of visibility to the naked eye. The announcement, of course, turned a host of observers to the new star, and many erroneous estimates and statements were made. Some observers estimated the brightness far too great, and several, on account of errors in the observations, announced that the new star was moving with an enormous velocity. It required the lapse of a few weeks to clear away and correct all this error.

"After Dr. Hartwig's announcement it appeared that several others had seen the new star, but for some reason, perhaps want of familiarity with this nebula and lack of confidence that a new star had really appeared, they did not make a public announcement. Thus the Baroness Podmaniczky, of Eastern Hungary, saw the new star on August 22 or 23 with a 3½-inch comet-seeker, and called the attention of a visitor to it, but they do not seem to have been certain that the object was new. This lady looked at the nebula on August 13, and did not see the new star. Mr. H. S. Moore, of McKinney, Tex., saw the new star on August 30. The circumstances indicate that this is a *bona fide* observation. A really independent discovery was made by Freiherr von Spiessen, of Winkel, in Rheingau, who found the new star on August 30. - - - Mr. Isaac W. Ward, of Belfast, Ireland, claims that he saw the new star on August 19, when it was of the 9½ magnitude. Finally, Prof. Ludoric Grelly, of Rouen, says that he saw the new star on the 17th of August, and showed it to several friends and visitors. On the other hand, Mr. Tempel, of Florence, Italy, who has done much work on nebulæ, and who is well acquainted with the great nebula of Andromeda, says that he is confident that there was no star in the place of the new one which was easily visible in his telescope on the 15th and 16th of August. This testimony is important and serves to fix the time of the appearance of the *nova*, or at least the time it became an easy object in telescopes, within very narrow limits. This time must have been between the 16th and 20th of August, 1885. It is probable that the star increased rapidly in brightness, since on August 31 it was of the 7th magnitude. It never,

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* See, also, *Amer. J. Sci.*, 3 ser., vol. 31, p. 299-303.

I think, became much brighter, though statements were made early in September that it was of the 2d or 3d magnitude and easily visible to the naked eye. Its diminution of brightness began about August 31, and has gone on pretty steadily until the present time [February, 1886]. - - -

"At first the position of the new star was confounded with that of the bright point of the nebula, and as this mistake added interest to the discovery it was some time before it could be generally corrected. - - - The assumption of any intimate physical connection of the new star with the nebula has been given up by Vogel, of Potsdam, and Hasselberg, of Pulkowa, who have examined its spectrum. Within the limits of this nebula there can be counted from fifteen hundred to two thousand telescopic stars, and one of these has proved to belong to the class of temporary stars, so called, of which we have records of from 20 to 30. What causes these stars suddenly to flame out and then to fade gradually away we do not know, and, so far as I know, there is hardly a plausible theory.

"I first saw the new star on September 6, when its magnitude seemed to me 7½, and the star had a decidedly ruddy tinge. This color lasted but a few weeks, and as the star grew fainter it became of a white color. My observations have been continued until February 7 of the present year, and probably the star will be visible in the 26-inch refractor after the present moon has passed. It is now very near the limit of visibility in our telescope, or of nearly the 16th magnitude. The passage from the 7th magnitude to the 16th corresponds to a very great change of brightness, since it is the passage from the limit of visibility to the naked eye to that in a 26-inch telescope. Several hypotheses were proposed to account for this wonderful star, and one that seemed to me quite ingenious is that of Mr. Monck, of Ireland, who assumed that this star is one of the swiftly-moving ones that in rushing through the nebula had been set on fire, like a meteor in our atmosphere. Led by some such suggestion, and also by that of Professor Peters that it would be interesting to test the parallax of such a star, on September 29 I began some measures of the new star by referring it by means of polar co-ordinates to a known star of the 11th magnitude, distant from it a little less than 2′. - - - I do not think my measures show any proof of a parallax, though they indicate, perhaps, a diminution of the distance, and even this may be sufficiently accounted for by variations in the light and color of the new star, since such variations would be likely to affect the measures. - - -

"The great nebula of Andromeda is easily visible to the naked eye, and doubtless it was known to the astronomers of very ancient times. Those astronomers watched the heavens with unaided vision much more carefully than do modern astronomers, and they were far better acquainted with the constellations. The old astronomers had a theory that this nebula was variable both in form and brightness. They had poor means of judging of its form, but it is possible that their estimate of brightness may be more trustworthy, and that our new star may be an old variable which has appeared before, causing the nebula apparently to vary in brightness." - - -

The new star near χ' Orionis.—Mr. J. E. Gore, of Beltra, Ballysadare, Ireland, discovered on December 13 a reddish star of about the 6th magnitude, following χ' (54) Orionis by about a minute and a half of time, nearly in the same parallel. Drs. Copeland and Becker observed it at Dun Echt on the 16th, and found it to be of the 6½ magnitude and of an orange-red color. They remark: "It has a very beautiful banded spectrum of the third type, seven dark bands being readily distinguished with the prism; the bright intervals seem full of bright lines, especially in the green and blue." M. C. Wolf has also examined the spectrum of this remarkable star at the Paris Observatory; he finds it to be of a totally different character from those of the stars which underwent such great outbursts of brilliancy in the constellations Corona and Cygnus in the years 1866 and 1876, respectively, and presenting, in fact, a great similarity to the spectrum of that extraordinarily variable star known as Mira or *o* Ceti.

SPECTRA OF STARS.

Stars with spectra of the third type.—"Professor Dunér has published an important catalogue of stars having banded spectra. Following Professor Vogel's classification, he prefers to regard the spectra with bands fading away towards the violet as a subdivision of the same type as those in which the bands fade away towards the red, rather than, with Secchi, to make them into a separate class. Dunér's type III *a*, therefore, corresponds to Secchi's third type, and his III *b* to Secchi's fourth type. Professor Dunér's purpose in forming this catalogue is to supply the means for future observers to detect changes in these spectra, should any such occur, for, as he points out, these stars are probably in a very advanced state of development, and we may therefore, perhaps, hope to discover some day changes in their spectra, which, carefully studied, may lead to important results as to the nature of suns. They are the more interesting, also, because variable stars of long period usually belong to this class.

"With this view Professor Dunér has carefully examined all the known objects of this type which are visible in his latitude, and for which the optical means at his command were sufficient, and he has catalogued 297 stars of type III *a*—that is, with bands shading off towards the red—and 55 of type III *b*, with bands shading off in the opposite direction. An important section follows, giving a list of stars which different astronomers have regarded as belonging to the third class, but which Dunér cannot so classify. Only in a very few instances, however, is there any good reason to suspect a change in the spectrum. In the great majority Secchi, whose observations supply most of these cases of discrepancy, had himself at one time or another registered the star as being of the second type, *i. e.*, without bands, or else had especially remarked on the extreme feebleness of the bands which he thought he saw. There are, however, three stars observed by D'Arrest for which the evidence of change seems stronger, viz, Lal. 24034, D M. + 60°, 1461, and D M. + 36°, 2772. Professor Dunér has also failed to find Schjellerup 249, which is, perhaps, a long period variable, and he draws special attention to R Andromedæ, a star the spectrum of which, though of type III *a*, presents some very marked peculiarities. Great care has been taken in the determination of the position of the bands in the different spectra. It is clear, as many spectroscopists have already observed, that the bands of type III *a* occupy the same positions in all the spectra of the type, and the same is true for the bands of type III *b*. With regard to the former class, the sharp dark edges on the more refrangible sides of the bands generally coincide with strong metallic lines. Thus one of the most prominent bands is terminated by the *b* lines of magnesium. The nature of the connection between the bands and these metallic lines is not at all clear at present, the symmetrical arrangement of the bands seeming to suggest that they are due to some one substance rather than to several. The three principal bands of the spectra of the other type Professor Dunér considers to be unmistakably those of a carbon compound, and to correspond to the bright bands so familiar in the spectra of comets. The determinations of the wavelengths of the bands in spectra of this type are necessarily not quite so accurate as those of the bands in spectra of type III *a*, but if Professor Dunér's measures are accepted, this most important correspondence may be considered fully established. But apart from the value of these measures, Professor Dunér's catalogue, with the full and clear descriptions he has appended to every star, will be of the utmost service to future observers of these interesting and beautiful objects." (*Observatory*, November, 1885.)

Bright lines in stellar spectra.—"Mr. O. T. Sherman has continued his researches on the spectra of γ Cassiopeiæ and β Lyræ, and announces in the *American Journal of Science* for December the discovery of no fewer than fifteen bright lines in the spectrum of the former star and seventeen in that of the latter. The lines seen in γ Cassiopeiæ are as follows: Hα, λ 6356, 6160, D_3, λ 5840, 5557·5, 5422, 5309·8, 5167·5, 4990, Hβ, λ 4623, Hγ, λ 4180, and Hδ, bright lines; and λ 6280, 5760, 5020, 4920, 4673·5, and 3993, dark lines. The bright lines agree closely in position with the principal lines observed by Professor Young in the spectrum of the chromosphere. Mr. Sherman has also examined a large number of other stars, and '*in each case* many or few bright lines have been seen, lines, so far as I know, formerly unsuspected.' It is clear, if Mr. Sherman's observations can be satisfactorily confirmed, that we have here a most important discovery; but, looking to the fact that these stars have probably been frequently observed by experienced spectroscopists without any bright lines being detected in them, whilst a false appearance of bright lines is readily produced in stellar spectra under certain circumstances, it would appear hazardous to accept Mr. Sherman's result without further evidence." (*Nature*, December 17, 1885.)

Periodic variations in the spectrum of β Lyræ.—Herr von Gothard reported last year (*Bull. Astron.*, I, p. 211) the appearance of the brilliant lines, which had not been seen for some time, in the spectra of γ Cassiopeiæ and β Lyræ. During the year he has been able to prove the periodic variability of the line D_3 in the spectrum of β Lyræ. The period seems to be very short, and is probably about 7 days. The hydrogen lines vary also, but their variation is less pronounced. The spectrum of γ Cassiopeiæ also offers some indications of analogous variations.

PROPER MOTION OF STARS.

Stars in rapid motion.—The small value of the parallax of 40 o^2 Eridani (*Science*, vi, 358), combined with its large proper motion (4″·10), brings it into prominence as the third or fourth of the stars moving rapidly across our line of sight. Since a list of these stars seldom appears in works on popular astronomy, we give below the proper motions μ, the parallaxes π, and the resulting velocities v, in miles per second across our line of sight, of the eight stars which head the list in the order of velocities. The method of deriving the velocities is of course very simple. If a star's annual proper motion equals its parallax, it moves across our line of sight each year a distance equal to the semi-major axis of the earth's orbit. (How much it moves to or from us can only be told by the spectroscope.) Therefore, since this motion increases directly as μ, and inversely as π, we have for the annual motion across the line of sight—

$$vt = a\frac{\mu}{\pi}$$

or, calling a 92.5 million miles, and t the number of seconds in a year, we have for the volocity in miles per second—

$$v = 2{\cdot}93\frac{\mu}{\pi}$$

Of course, the proper motions below are much more accurately known than the parallaxes, and where the latter are small the values of v are correspondingly uncertain. The authorities for the adopted values of π are given in the column following them. In the case of 40 o^2 Eridani, we have weighted Gill and Hall 2 and 1 respectively, as the former determination was made under much the more favorable conditions, and rests upon two comparison stars. The latest values of Hall and Ball for 61 Cygni are practically identical. The probable errors of all the values of π are generally less than 0″·02.

Star's name.	μ	Parallax.		v
		π	Authority.	
Groombridge 1830	7″·05	0″·09	Brünnow	230
Lacaille 9352	6 ·96	0 ·285	Gill	71
40σ^2Eridani	4 ·10	0 ·185	Gill and Hall	65
e Eridani	3 ·10	0 ·14	Elkin	65
ε Indi	4 ·68	0 ·22	Gill and Elkin	62
Lalande 21258	4 ·40	0 ·27	Auwers	48
61 Cygni	5 ·23	0 ·48	Hall and Ball	32
Lalande 21185	4 ·75	0 ·50	Winnecke	28

The first will be recognized as Newcomb's "runaway star," so graphically described in his Popular Astronomy; but it will be seen that the others have velocities which are at least comparable with that of Groombridge 1830, and indicate momenta that represent vast amounts of energy. The discovery of huge suns like our own rushing through space with these great velocities is a matter of more than usual interest just now, from the fact that Mr. Denning's claimed discovery of fixed meteor-radiants has raised the question as to the possible existence of broad swiftly flying streams of meteorites in interstellar space, moving with velocities entirely beyond the control of our sun, and so broad that it takes the solar system some years to pass through them. (An annual parallax of 1° in a meteor-radiant corresponds to a velocity of over 1,000 miles per second for the meteor stream.) The idea of such streams moving with such velocities is a startling one, and, if shown to be true, gives a very vivid idea of the forces acting, or which have acted, in stellar space. It seems at first highly improbable that such can be the case, but with the hard facts of Groombridge 1830 and these other swiftly flying suns staring us in the face, the idea is worth considering, at any rate. If these suns are the products of condensation due to central attraction, so that the luminous energy by which they reveal themselves to us was once energy of translation, it is no violent assumption to suppose that some of their constituent parts were once moving with much greater velocities than that of the present whole. In fact, the man who should claim as a possibility that space contains broad belts of small particles moving with velocities which are the resultant of all the forces acting on them since primeval chaos, and which have not yet been gathered into the control of any of the stellar systems among which they are sweeping, would find much to confirm his ideas in these giant swiftly flying suns. The question is certainly of sufficient interest and importance to call for a thorough overhauling of the present methods of determining meteor-radiants, for probably most astronomers would to-day be disposed to deny *in toto* the existence of the greater part of these so-called radiant-points." (H. M. Paul, *Science*, November 27, 1885.)

Star with large proper motion in Sculptor.—Dr. Gould has noticed a case of large proper motion in a star in Sculptor, barely of the 8th magnitude (R. A. $=23^h\ 58^m$, Decl. $= -37° 58'$). It appears to have a proper motion of $+0^s{\cdot}482$ and $-2''{\cdot}45$, or $6''{\cdot}21$ in the arc of a great circle. This motion is only less than that of Groombridge 1830 ($7''{\cdot}03$), and that of Lacaille 9352 ($6''{\cdot}96$), which precedes the star in question by 1^h and is upon nearly the same parallel. The star is numbered 1584 in Hour XXIII of the Cordoba Zone-Catalogue.

Proper motion of Lalande 16616.—Professor Frisby has found* a proper motion of $-0^s{\cdot}00920 \pm 0^s{\cdot}0013$, in right ascension and $-0''{\cdot}3619 \pm 0''{\cdot}0048$ in declination for this star, from observations of Lalande, Argelander, Robinson, and Washington transit-circle observations in the years 1881 and 1882.

A large proper motion has been detected by Herr Berberich in the star Weisse X 1021; and Professor Porter has called attention to proper motions in the stars Lalande 20959 and 24423.

Proper motions in the Pleiades.—Professor Pritchard has published in the forty-eighth volume of the *Memoirs of the Royal Astronomical Society* a paper of some 50 pages, "On the relative proper motions of forty stars in the Pleiades, determined from micrometric and meridional observations."

Motions of stars in the line of sight.—"For the past ten years the Royal Observatory of Greenwich has been assiduously observing the spectra of more than 50 of the brightest stars, for the purpose of determining the velocity of their motions toward or from the earth in the 'line of sight'—the line joining the earth and star. The reports of the astronomer royal have given the annual results, but no general exhibition of the present state of the question has been made until lately, when Mr. Maunder, the observer, has collected them in an interesting paper in the *Observatory.* Mr. Maunder points out, in the first place, that the conclusions which are drawn are worthy of confidence in spite of the extremely small displacements of the spectral lines upon which they depend. The entirely independent researches at Greenwich and those of Dr. Huggins and Dr. Vogel mutually confirm each other; and, moreover, if the method is applied to the measurement of the difference between the velocity of approach of the two limbs (edges) of the sun or Jupiter, the results are consistent with what we know of the rotation-times of these two bodies. We can compute exactly how fast one limb of the sun is approaching us, and how fast the opposite limb is moving away; and these same quantities can be determined by the spectroscopic methods with substantially the same results. Hence the spectroscopic determinations of the velocity of a body in the line of sight may be fairly said to belong to exact astronomy. The directions and the velocities for some fifty stars have been thus determined at Greenwich by measures extending over several years. Velocities of thirty to forty miles per second are not uncommon. A velocity of less than ten miles corresponds to such a small displacement that its determination becomes difficult. The case of Sirius is an interesting one, from the fact that its motion has changed from a recession of 21 miles per second in 1875–'76 to an approach of 21 miles per second in 1884. The proof is very clear, the separate years giving:

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* *Astron. Nachr.*, 2683.

1876	21 miles per second;	recession
1877	23 miles per second;	recession
1879	15 miles per second;	recession
1880	11 miles per second;	recession
1881	2 miles per second;	recession
1882	5 miles per second;	approach
1883	19 miles per second;	approach
1884	21 miles per second;	approach

"But the interest of this research is not in accumulating data as to the motion of individual stars, however important this may be. The real point is, what light does this method throw upon the theory that the sun, with the whole solar system, is moving toward the constellation Hercules at a rate of some 590,000,000 miles per annum? Attempts have been previously made to show that the spectroscopic data confirm the theory, which, indeed, has a fairly firm basis on other grounds. Mr. Maunder declares that these attempts are premature, and that the spectroscopic data are as yet insufficient. So far as they go, they rather indicate a motion toward α Aquarii. 'Still, if the sun's speed be small compared with the average speed of the stars observed, there is nothing in the observations incompatible with the generally accepted direction.' Mr. Maunder points out the fact that Greenwich Observatory is the only observatory prosecuting these researches, which demand a refined spectroscope, a large telescope, and a very clear and quiet atmosphere—conditions all lacking at the Royal Observatory. He expresses the hope that the observatories of Nice and Melbourne may devote their large telescopes to this work. In America we have several large refractors admirably suited for the work, and it is to be hoped that some of them may be exclusively devoted to it." (*Nation*, June 11, 1885.)

PHOTOMETRY.

Standards of stellar magnitudes.—The third report of the American committee on standards of stellar magnitudes states that the zones following the twenty-four selected equatorial stars have received a second careful revision with the Princeton 23-inch, which should make them include all stars down to about 16·0 magnitude, and that a revision will probably be made with the Washington 26-inch. Four of the charts have been distributed to all observatories having large telescopes, with requests for all visible additions which will furnish comparisons of the penetrating power of different kinds of telescopes. Certain selected standards in each zone, about 0·5 magnitude apart, have been measured at the Harvard College Observatory with photometer I, and the two brightest, if not too faint, with the meridian-photometer. A catalogue of these selected standards in the twenty-four zones, giving the positions and provisional magnitudes, is published, and also a table of twenty-one close circumpolars ranging in magnitude from 2·2 to 15·7. (*Science*, "Astron. Notes.")

Harvard Photometry.—M. Th. Wolff, of the Bonn Observatory, reviews at considerable length (40 pages) the last volume of the *Annals of the Harvard College Observatory*, which contains the photometric investigations of Professor Pickering and his assistants. M. Wolff has submitted the work of the American astronomers to a minute examination and has established very interesting relations between the results of the Harvard College meridian photometer and the results of his own work with a Zoellner photometer. With the latter photometer the observed star is compared with an artificial star, while with the meridian photometer the observed star is compared with Polaris. The two images, one formed by the ordinary and the other by the extraordinary ray of the respective stars, meet in a double image prism and are observed across a Nicol prism. As a check on the work, Polaris was often compared with itself. The magnitudes obtained vary from 1·4 to 2·7, the mean of 630 determinations being 1·90 instead of 2·0, the magnitude adopted for Polaris. This discerpancy is inexplicable. The mean of the differences between Professor Pickering's catalogue and M. Wolff's two catalogues is ± 0·11 magnitudes, or for the logarithm of the intensity ± 0·044. It is a matter for regret that Professor Pickering did not publish the relative intensities that were the direct results of observation, but preferred to give the magnitudes computed by Pogson's formula, with the constant 0·4. M. Wolff very justly remarks that this constant, determined by the observation of telescopic stars, cannot apply to stars of the first six classes; he finds that to establish an agreement with Argelander this constant must be reduced to 0·37, or even to 0·33. Professor Pickering has endeavored to make his work agree with Argelander's by adding + 0·27 to all his results; but this reduction has altered the discrepancies without doing away with them. By reducing the numbers published by Professor Pickering back to the logarithms of intensity from which they were derived, and comparing these results with his own, M. Wolff finds the following mean result:

$$W - W_0 = 0{\cdot}84\ (P - P_0),$$

which would indicate the existence of an unexpectedly large personal equation. (*Bull. Astron.*, August, 1885.)

*The Oxford Uranometria.**—"The form of photometer Professor Pritchard has adopted is now too generally known to require description. It possesses the high merits of simplicity of construction and use and freedom from liability of derangement. In addition to these qualities, Professor Pritchard has been careful, in his use of it, to free it from systematic errors arising from the continual use of the same part of the wedge for the same star. Not only has the coefficient of absorption been separately determined for every point of the wedge, but the system of observation adopted has involved the employment of four different apertures of telescope in conjunction with two wedges, and by two different observers. Each determination of magnitude, therefore, is the mean of twenty observations, a set of five observations being taken with each of what are practically four different instruments. When to this is added the circumstance that the determinations of magnitude are differential only, and that therefore three complete sets of extinctions were made of the standard star Polaris every evening, and that for the better determination of the atmospheric absorption and of the magnitudes of southern stars a considerable portion of the observations were made at Cairo, it becomes evident that the work of determining the magnitudes of nearly 3,000 stars which Professor Pritchard, with his assistants, Messrs. Plummer and Jenkins, has here accomplished, is one of very considerable dimensions indeed.

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*Astronomical observations made at the University Observatory, Oxford, under the direction of C. Pritchard, D. D., F. R. S., F. G. S., F. R. A. S., Savilian Professor of Astronomy in Oxford.—No. II. *Uranometria Nova Oxoniensis.* A photometric determination of the magnitudes of all stars visible to the naked eye from the pole to ten degrees south of the equator. Oxford: At the Clarendon Press.

"The convenience of Professor Pritchard's photometer, and the magnitude of the work he has undertaken with it, stand beyond dispute; but the delicacy of the wedge is another question. And here we are met with the circumstance that the observations seem to show little or no evidence of any effect due to changes in the sensitiveness of the observer's eye, to personality, to moonlight, and only to a small extent to color in the star observed; and this unexpected and remarkable result has called forth not a little criticism, for as the construction of this photometer is not such as to lead us to expect that it would be wholly free from errors of these kinds, a doubt seems to be thrown upon its sensitiveness. Professor Pritchard has replied to these criticisms in the frankest manner, showing that they had not escaped his notice; but whether he has quite refuted them is a point which we may, however, well think still *sub judice.* Probably the wise arrangement by which an ordinary evening's work is confined to three hours or less will largely explain the absence of deviations due to the first-named cause, and with regard to the third it is most likely that observations on bright moonlight nights or of stars near the moon have been generally avoided. The observations of Polaris which Professor Pritchard has brought forward in this connection scarcely touch the real difficulty. The *substantial* accuracy of the Oxford star magnitudes is, however, shown by the close agreement which they bear to determinations made at other observatories and by widely different methods, and it is possible that the future may show that the exceedingly small deviations of the individual observations are a true index of the minuteness of their errors." (E. W. Maunder, *Observatory.*)

Photometric observations at Potsdam.—Professor Safarik has made quite an extended analysis of Dr. Müller's *Photometric Researches*, which have appeared in the Publications of the Potsdam Observatory (1883). These researches have been carried on since 1877, their object being the study of atmospheric extinction and of the relative brightness of the planets and of a series of variable stars. The instrument employed by Dr. Müller is a Zoellner photometer, with an aperture of 0·037 meter. The aperture of the objective may be reduced by diaphragms; it seems, however, that the effect of the diaphragms does not always correspond to the expectations based upon the diminution of the aperture. Professor Safarik thinks the cause of this disagreement must be sought in the employment of a magnifying power that is much too low, so that the resulting ocular ring is larger than the aperture of the pupil of the eye. This photometer is not suitable for colorimetric researches.

Dr. Müller's observations relative to atmospheric extinction have consisted in comparing the five following stars, which can be observed at widely different zenith distances, with Polaris: α Cygni, η Ursæ Majoris, δ Persei, α Aurigæ, and α Tauri. Curves have been traced representing the logarithmic intensities as a function of the zenith distance. These curves show no indication of variability for the six stars in question, unless it be in the case of α Tauri. It is a curious fact that the white stars do not become quite as much fainter in the neighborhood of the horizon as the red stars do. This is probably due to some physiological cause. We give here some of the values finally adopted for reduction to the zenith (the numbers given are the logarithms):

Z. D.	Reduction.	Z. D.	Reduction.
10°	0·0004	75°	0·2596
20	0·0037	80	0·3908
30	0·0112	82	0·4718
40	0·0244	84	0·5959
50	0·0482	86	0·8164
60	0·0920	87	0·9929
70	0·1798	88	1·2409

Four units in the first decimal place being equivalent to one magnitude, we see that for Z. D.=80°, 86°, 88°, the reduction represents 1, 2, and 3 magnitudes respectively. Dr. Müller's curves offer as a whole a very satisfactory agreement with those of Seidel, in spite of the difference of climate between Potsdam and Munich, and in spite of the different processes employed in the two observations. Dr. Müller finds the mean value 0·8250 for the fraction of a star's light that comes through our atmosphere when the star is seen in the zenith; the atmosphere then absorbs a little more than $\frac{1}{6}$ of the light. The coefficient of extinction should thus be 0·8250 (0·21 magnitude); Seidel found it to be equal to 0·100 (0·25 magnitude). Professor Safarik speaks in conclusion of the recent work done by Wolf, and Langley." (*Bull. Astron.*, September, 1885.)

Photometry of the Pleiades.—"A valuable memoir (*Mémoires de l'Académie Impériale des Sciences de St. Petersbourg*, VII *série, tome* XXXII, *No.* 6), by Herr Ed. Lindemann, of Pulkowa, 'On the magnitudes of Bessel's stars in the Pleiades,' has recently reached us. A special point of interest lies in the fact that Professors Pickering and Pritchard have likewise determined the brightness of many of these stars with their respective photometers, each assuming the magnitude of Merope, to which the other stars of the group are referred, as 4·22. Herr Lindemann has also adopted the same magnitude for Merope, which he has used as his standard star. He also employed, as reference stars, Celæno and Anon. 32, the magnitudes of which he had determined to be 5·27 and 6·51, respectively. The stars, fifty-two in number, were each observed on two separate nights, only one star of the fifty-three observed by Bessel proving too faint for Herr Lindemann's telescope of five inches aperture. Comparing his own results with those of Professors Pickering and Pritchard, Herr Lindemann finds, on the whole, a very gratifying agreement; twenty-five stars observed by Professor Pickering showing a mean excess over the Pulkowa observations of 0·04 of a magnitude, and thirty-three stars observed by Professor Pritchard giving a mean excess of 0·05. Professor Pritchard's later observations give a yet smaller difference, viz, 0·01 of a magnitude. When it is remembered that the three photometers employed—Herr Lindemann using a Zoellner photometer—differed entirely in principle, construction, and method of employment, this close agreement would seem to indicate that each may be relied upon with very considerable confidence when the differences of stellar magnitude determined by their means are not very great. The stars Nos. 1, 4, 21, 31, and 33 would appear to be variable, and possibly two others likewise. Pogson's scale has been employed for the conversion of the logarithm of the light of the star into magnitude." (*Nature*, December 17, 1885.)

Professor Pickering in the *Proceedings of the American Society for Psychical Research* has tried to find out from the discussion of a large number of observations, whether the knowledge of a catalogue magnitude of a star on the part of a recorder exerts through the medium of "thought-transference" any influence upon the independence of the observer's estimate. His conclusion is in the negative.

ASTRONOMICAL PHOTOGRAPHY.

Photographic map of the heavens made, with the aid of two objectives, by Paul and Prosper Henry.—"In their first attempts at stellar photography the Messrs. Henry had especially in view the discovery of some rapid means for the construction of their ecliptic charts. As these first attempts gave excellent results, M. Mouchez had apparatus constructed that was especially adapted to stellar photography; the mechanical part is due to Gautier, the optical part being the work of the Messrs. Henry. This new instrument consists of two telescopes in juxtaposition, each having about the same focal length (3·60 meters), and apertures of 0·24 meter and 0·34 meter respectively. The latter telescope, which serves for the photography, is rendered achromatic for chemical rays; the other telescope is used as a pointer in keeping the image of the star at exactly the same point of the photographic plate for the requisite length of time; the field is about 3°. The Messrs. Henry have recently succeeded in obtaining, with an exposure of one hour, a very beautiful proof, which has been presented to the Academy by M. Mouchez. It represents an expanse of about 5° and shows 2,790 stars between the 5th and 14th magnitudes. Such a chart as this one, obtained in one hour, would have certainly required a number of months to prepare by ordinary methods." (*Bull. Astron.*, June, 1885.)

Photographic charts of regions of the Milky Way, by Paul and Prosper Henry, of the Paris Observatory.—"About 5,000 stars between the 6th and 15th magnitudes can be counted on the plate presented to the Academy by M. Mouchez. The plate shows an area of 2° 15′ of right ascension by 3° of declination, and was obtained by the new photographic apparatus described in vol. II, p. 289, of the *Bulletin Astronomique.* In order to avoid confounding flaws in the plate with stars three successive exposures of an hour each were made, the telescope being moved 5″ each time, so that each star is represented by three points forming an equilateral triangle, the sides being 5″ in length.

"M. Mouchez estimates that 6,000 similar plates would be required to represent the whole sky, and that these would form 1,500 charts of the size of the ecliptic charts of the Paris Observatory." (*Bull. Astron.*, August, 1885.)

Photograph of the star cluster of Perseus.—"During September, 1884, Dr. Lohse took advantage of exceptionally clear nights to attempt some star photographs, using the 11-inch refractor belonging to the Potsdam Observatory. An exposure of 45 minutes generally sufficed for obtaining photographs of stars as faint as 10th to 11th magnitude. The finder of the telescope was employed as a pointer in correcting the errors due to the driving clock; but it would have been better to point the telescope directly by means of an eye-piece inserted in the photographic chamber. Such an arrangement has been invented by Mr. Common. Two successive positions of the most brilliant star of the group have always been reproduced for the purpose of fixing upon the plate the position of the apparent parallel. The sensitive plates were furnished by Wratten and Wainwright of London. The images were developed by a concentrated solution of oxalate of iron, to which was added potassium bromide. The development can be hastened by plunging the plates for about two minutes into a very weak solution of nitrate of chrysaniline.

Dr. Lohse has succeeded in this way in photographing a certain number of star clusters, and in particular the cluster χ Persei, which Dr. H. C. Vogel studied in 1878. A negative obtained September 24 served to identify the stars by micrometer measures, and one obtained September 26 served to determine the magnitudes. The plates showed 57 stars between the 6th and 11th magnitudes. It is certain that the photographic determination of the relative positions of so many stars represents a very considerable economy of time, and also guards against personal errors. As for the errors of the photograph, they can always be detected by the simultaneous reproduction of a squared reticle. Five successive exposures of 1^m, 4^m, 9^m, 16^m, 25^m, respectively, were made for the purpose of determining the magnitudes, the telescope being each time moved in declination. Five series of images, each more numerous than the last, were thus obtained. The photo-chemical effect is known to be proportional to the intensity of the light and to the time of the exposure; in cases of equally distinct images, therefore, the brightness of the stars must be inversely proportional to the time of exposure. Dr. Lohse has proceeded upon this principle in determining the relative magnitudes of the stars in the cluster of χ Persei, employing Dr. Vogel's actinometric data. (It seems that the photographic intensities of two successive magnitudes are in the ratio of 1 : 3, while the ratio of intensities as seen with the eye is that of 1 : 2·5.) Photographic magnitudes generally agree well enough with optical magnitudes; still there are some exceptions: thus a red star called 8·5 by Dr. Vogel is marked 10·5 by Dr. Lohse. It would be interesting to apply the same process to the actinometric study of variable stars.

We must not neglect to speak here of the fact that MM. Henry have obtained a very beautiful photograph of the star cluster of Perseus at the Paris Observatory. They succeeded in locating 509 stars between the 6th and 13th magnitudes included within 1° of right ascension and 1°·5 of declination." (*Bull. Astron.*, March, 1885.)

Stellar photography at Harvard College Observatory.—By the aid of the Bache fund an important investigation has been undertaken in stellar photography. It is found that stars as faint as the 6th magnitude, in any part of the sky, can be readily photographed, even without clock-work; while near the pole, where the diurnal motion is slower, stars as faint as the 14th magnitude may be photographed in like manner. These results have much value as a means of determining the relative positions and brightness of different stars. Charts of regions five degrees square can also be photographically prepared and enlarged by photolithography to the scale of the maps drawn by Chacornac and Peters. The spectra of stars have all been photographed with much success. Stars as faint as the 8th magnitude give photographic spectra in the paper prints, from which the lines can be distinctly seen. Mr. W. H. Pickering has rendered important aid in this investigation. A part of his researches upon the possibility of photographing the solar corona, except during an eclipse, was conducted at the Observatory and the results published in *Science*.

The first stellar photographs ever taken were those of α Lyræ, by the elder Bond, at the Harvard Observatory, in 1850. In 1857 his son carried similar investigations much further. At first, however, they were unable to obtain clear images of stars of the 2d magnitude, while now it is possible to print those of the 14th, or, in other words, to transfer to paper an image produced by an object only a hundred-thousandth part as bright as formerly. Professor Pickering's researches have been carried on with an instrument that he has devised himself, in which a Voigtlander portrait lens of 8 inches aperture and 44 inches focus has been reground and mounted equatorially. It is driven by clockwork, having a Bond spring-governor, controlled electrically by a sidereal clock.

We have already referred (under Nebulæ) to the fact that Professor Pickering has found upon one of his plates a trace of the nebulæ around Maia, discovered by the Henrys at Paris.

Stellar photography at the Cape Observatory.—Upwards of one hundred successful photographs have been obtained towards the completion of a photographic Durchmusterung of the southern heavens. Each photograph covers a square of 6° on the side, and shows all stars similar in magnitude to those of Argelander's Durchmusterung. The lens employed is a "rapid rectilinear lens," composed of two combinations, having an aperture of 6 inches and a focal length of about 52 inches. The exposure of each plate is one hour, and the plates are the most sensitive "Paget dry plates," specially made for that purpose. Mr. Finlay, of the Cape Observatory, stated at a meeting of the Liverpool Astronomical Society, on October 13, 1885, that a 9-inch lens had been ordered and would soon be ready. It is proposed to divide the whole southern hemisphere into sixty squares, each one overlapping another adjoining it. Two plates are taken of each picture, so as to avoid any mistake. The work will take from three to four years, and will comprise 1,000 pictures. Mr. C. Ray Woods has been put in charge of this work, and he intends to continue at the Cape the work of photographing the corona, which he lately undertook, under Dr. Huggins' direction, in Switzerland.

COMETS.

Theory of comets' tails: Les syndynames et les synchrones dans les comètes, 25 pp., 1 plate, 4to. *Les syndynames et les synchrones de la comète Pons-Brooks*, 24 pp., 1 plate, 4to.—"M. Bredichin, while sharing some of Bessel's ideas concerning the existence of a repulsive force, has succeeded in developing a complete theory concerning the tails of comets; a theory which accounts very satisfactorily for most of the observed phenomena. M. Bredichin applies the name *syndyname* to the parabolic curve in which the particles of the tail that have successively left the nucleus under the influence of a given repulsive force μ, are disposed at the moment of observation. The *synchrone* is the curve in which occur the particles that have left the nucleus at the same time under the influence of several forces μ, μ', ...

"The synchronic lines are limited and intersected by the syndynames of the edges of the tail. In the case of the Donati comet, Norton found these lines to be nearly straight, passing near the nucleus. According to Bredichin, the synchrones are rather circles of great radius, the radius for each comet increasing and diminishing with the radius vector. When the emission of matter is intermittent, the synchronic circles signalize the maxima by clear bands converging toward the nucleus. The clear bands are really hollow conoids, more or less flattened in the direction of the plane of the orbit.

"In the two memoirs before us, which are taken from the Annals of the Moscow Observatory, M. Bredichin successfully applies his theory to different comets, of which we possess sufficiently accurate drawings, and especially to the comet of 1744 and to the Pons-Brooks comet (1884). They also contain a reproduction of the refutation of the criticisms of M. Marcuse." (Radau, *Bull. Astron.*, September, 1885.)

Computation of comet orbits.—In the twentieth volume of the *Vierteljahrsschrift der Astronomischen Gesellschaft* (pp. 287–312) will be found in full Professor Weiss's exceedingly interesting report on the present state of the computations of the orbits of comets, presented at the meeting of the Gesellschaft on the 19th of August, 1885. *Nature* contains the following report of this communication:

"Of the twelve periodical comets returned at different times to their perihelion, eight had again been regularly determined by the same calculators. Of the remaining four, three were removed from our present care: Biela's, which, as was known, had been lost to observation, and the comets of Halley and Pons-Brooks, whose next perihelion lay too remote in the future. There was consequently but one periodical comet (Brorsen's) to be taken account of. As to the remaining non-returning comets, of the 168 which had appeared in this century, forty-one were to be regarded as settled; twenty-three had their orbits pretty well determined. In the case of fifty-eight comets a new calculation of the orbit was desirable for various reasons, and in all forty-six had yet to be calculated definitely. There was, therefore, a wide field of labor open. Professor Weiss accordingly sought to commend to the society the establishment of a common calculation bureau on the settlement of the questions at issue, while the exact detailed treatment of a particular comet should in future, as hitherto, be left to the initiative of a single calculator. In the discussion following this address, Staatsrath Struve argued against the founding of such a bureau on the ground that the comets were of too peculiar a nature to accommodate themselves to the methodic treatment of a calculation bureau."

Holetschek: Uber die Bahneines Kometen, der - - - nicht aus den Sonnenstrahlen heraustreten kann Wiener Sitzungsberichte, December, 1883, (88: 1099–1162.)—It will be remembered that at the time of the total eclipse of May 17, 1882, the French, English, and Italian astronomers who met at Sohag, Egypt, observed the presence of a comet near the sun;

it was photographed by Tacchini and Schuster, and a drawing made of its tail by Trépied; but the comet was not seen again. It was this incident that induced Herr Holetschek to determine the conditions that must be fulfilled by the orbit of a comet that remains concealed by the sun's rays during the time that its absolute brightness (determined simply by the formula $J=\frac{1}{r^2\rho^2}$) is sufficient to admit of its discovery.

Herr Holetschek judges from the examples furnished by the comets of the last ten years that the magnitude of a comet remaining invisible at its perihelion cannot be greater than from 0·06 to 0·12 for an elongation approaching 15°, certainly not for one of 22·5° (the calculation was made for these two elongations). In order that it may remain visible in the two branches of its orbit, its orbit must offer a certain symmetry in reference to the earth's radius vector; the heliocentric latitude of the perihelion must then be sufficiently small, and the comet must be in conjunction with the sun at the time of its passing its perihelion.

These results, which are not at all rigorous, suffice to show that the unobserved perihelion transits of comets may not be as infrequent as would have been supposed. We know of periodic comets whose returns sometimes elude observation. But there are others which would have always remained unknown if their transit had occurred at any other time of the year; such, for example, is the comet of 1821 ($q=0.09$, $i=106°$). The Sohag comet belongs very probably in the same category as this last; its perihelion distance must have been very small. (Radau, *Bull. Astron.*, July, 1885.)

Galle's supplementary list of recent comets.—Dr. J. G. Galle, the eminent director of the Breslau Observatory, has communicated to the *Nachrichten** (Nos. 2665 and 2666)† a most valuable summary of the orbit elements of comets from 1860 to 1864, with a similar list of newly computed orbits of comets earlier than 1860. Brief notes generally relating to the discovery and period of visibility of the comet, and to the elements given, accompany each orbit.

Dr. Galle's paper has been reprinted in *Sirius*, vol. 18, and a translation of the portion relating to comets since 1860 has appeared in the *Sidereal Messenger* (vols. 4 and 5). The present list is supplementary to the catalogue given in the third edition of "Olbers' Methode zur Berechnung der Cometenbahnen," so that taken in connection with the latter it forms the most complete catalogue of comets that is now available. At the end of the year 1884 the number of different comets of which orbits have been computed was 302. The number of apparitions of comets, including the present recorded returns of periodic comets, is considerably greater:

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* Ueberischt über die Bahn-Elemente der seit dem Jahre 1860 exschienenen Cometen, sowie über neu berechnete oder verbesserte Bahnen von Cometen der früheren Zeit.

† See also *Astron. Nachr.*, 2692.

D'Arrest's comet has been observed 4 times.
Biela's comet has been observed 6 times.
Brorsen's comet has been observed 5 times.
Encke's comet has been observed 23 times.
Faye's comet has been observed 6 times.
Halley's comet has been observed 7 times.
Pons's comet has been observed 2 times.
Tempel's (1) comet has been observed 3 times.
Tempel's (2) comet has been observed 2 times.
Tempel's (3) comet has been observed 2 times.
Tuttle's comet has been observed 3 times.
Winnecke's comet has been observed 4 times.

Accordingly, 67—12=55 repeated apparitions are to be added, bringing up to 357 the total of the observed appearances of comets. In this summary, of course, no allowance is made for the great uncertainty of many of the older orbits, or for the fact that in some cases it is doubtful whether the *same* periodic comet has been seen.

The comets are arranged strictly in the order of their perihelion passage. This is a long-established system and one possessing numerous advantages; furthermore, it has lately been made the rule of the *Astronomische Gesellschaft.* The uncertainty sometimes existing in the designation of particular comets during the year of discovery can always be easily removed, for the time being, by the addition of the name of the discoverer. Moreover, a strict adherence to this system of numbering comets in each year has become necessary of late, partly on account of the great number of comets discovered, and partly on account of the considerable increase of the known periodic comets during the last forty years. The actually observed returns of these comets must of course be arranged with the other comets. Since in many cases the periodicity has first been established at the second apparition, and in a few cases at the third, the exclusion of periodic comets from the list of apparitions of each year would frequently cause annoying changes in the designations of earlier years. In the publications of the past ten years the periodic comets, particularly, have led to a great many differences in the designation of comets, an evil which is not merely of a theoretical nature, but, for those who often have occasion to refer to the literature of comets, is one which carries with it very real and practical inconveniences, frequently necessitating much troublesome comparison of observations, or of ephemerides, to decide what comet is really referred to. Especially in years in which a great many comets are seen, if the names of the discoverers are not given, not only is there great loss of time, but besides this mistakes easily occur.

Comets of 1883.[*]—The great comet of 1882 (1882 II), which excited so much interest in the latter part of the year 1882, was visible to the naked eye till February, 1883, and with the telescope was followed, in the southern hemisphere, to the middle of the year, the last accurate observation being on May 26, at Cordoba. The comet was seen again on June 1 at the same place, but was too faint to admit of a satisfactory determination of its position. It was then at a distance of 5·1 from the sun and 4·4 from the earth. In addition to this comet, two others were visible during the year, 1883 I and 1884 I; and a comet discovered on January 7, 1884, was found to have passed perihelion on December 25, 1883, and is accordingly catalogued with the comets of the latter year. A comet was also reported as Comet *c*, 1883, on September 11, but it proved to be a nebula; and a second comet, with a tail 2° or 3° long, was reported as seen before sunrise at Tasmania on the mornings of December 25 and 27, 1883. Nothing more is known of it. Two other comets have passed perihelion during the year, but, owing to unfavorable circumstances, have not been seen—D'Arrest's comet on January 13, 1883, and Tempel's comet of 1873, on November 20.

Comet 1883 I:
=Comet *a* 1883.
=Swift-Brooks Comet.

Discovered February 23, by W. R. Brooks of Phelps, N. Y., and on the same day, a few hours later, by Swift, at Rochester. The comet had already passed perihelion (on February 18). Its orbit does not resemble any previously computed, nor does it show any signs of eccentricity. The spectrum was of the ordinary three-band type.

Comet 1883 II:
=Comet *a* 1884.
=Ross's Comet.

This comet was discovered by Ross, an amateur observer, at Elsternwick, near Melbourne, Australia, on January 7, 1884. The spectrum showed faintly the three hydro-carbon lines. A careful discussion of the orbit has lately been made by Mr. Bryant. The observations are few and not very satisfactory, and Mr. Bryant finally based his results on Tebbutt's observations alone. Two sets of elements were derived; one gave a period of eighty-seven years, and the other ninety-four years, but both orbits satisfy the observations.

Comets of 1884.—Of the five comets visible during the year, four were periodic—two of these of short period, and observed apparently for the first time at this return. The first comet discovered during the year has just been described as Comet 1883 II. The second discovery was by Barnard on July 16, and the third by Wolf, on September 17. To these we add Encke's Comet, 1885 I, detected by Tempel, at Arcetri, on December 13, and the Pons-Brooks Comet, which passed perihelion on January 25. To complete the list we should mention a suspected comet to which some interest is attached: A faint nebulous object was found by Spitaler with the 27-inch refractor of the Vienna Observatory, while searching for Comet 1858 III, on the morning of May 26, 1884. A period of almost unexampled bad weather followed, and on June 17 and 18 the of nebula was missing. Schulhof seems to think it improbable that this was the comet. Brorsen's Comet, which has a period of about five and one-half years, was due at perihelion in September, 1884, but owing to its unfavorable situation it seems to have escaped observation.

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[*] This section is purposely made to include the comets of 1883, 1884, and 1885, in order to complete former records.

Comet 1884 I:
= Comet *b* 1883.
= Pons-Brooks Comet.
= Pons Comet 1812.

A faint telescopic comet was discovered by Brooks on September 1, 1883, and it soon proved to be a comet which had been discovered originally by Pons, at Marseilles, on July 20, 1812—one of a group, of which Halley's Comet is another member, having a period of about seventy-five years and an aphelion a little beyond the orbit of Neptune. Schulhof and Bossert's careful rediscussion of the observations of 1812 had placed the return to perihelion on September 3, 1884, whereas perihelion passage was actually found to take place on January 25. A closer agreement (the error was only $\frac{1}{122}$ of the whole amount) could hardly have been expected, considering that the older observations extended over barely two months. The corrected elements make the period 71·56 Julian years. As the second member of this group to return to perihelion, this comet had been looked for with considerable interest, and that interest was subsequently increased, when observation showed the rapid changes suffered by the head in approaching the sun, and the curious fluctuations in the brightness of the nucleus. On the evening of September 22 the comet was described as a faint, round nebula, with a nucleus of the 12th magnitude. On September 23 the nucleus had become as bright as the 8th magnitude. This central mass, according to Schiaparelli, was not a point of light, but had an appreciable diameter, and an irregular outline. It now diminished quite rapidly in brightness, and was noted as the 9th magnitude on September 29. Another outburst occurred on January 1, 1884, and a careful series of photometric observations was obtained by Dr. Mueller, of Potsdam. The nucleus became as bright as a star of the 7th magnitude, the change in brightness amounting to more than a magnitude in about an hour and a half. The comet was visible to the naked eye from November 20 to March 3, and at its brightest, with a tail 6° long, it was a fairly conspicuous object in our southwestern sky. The spectrum on the 24th and 27th of September showed nothing unusual. On January 1 Vogel found a continuous spectrum of considerable intensity, in which two bright lines were suspected in the yellow. The bands were fainter in the nucleus than in the parts immediately surrounding it. Vogel concludes from his observations that in consequence of the rapid condensation of the cometary matter into a bright nucleus of several seconds in diameter, a considerable increase in temperature must have taken place, by which the most refrangible band in the comet's spectrum increased so in intensity that it almost equaled the brightness of the middle band, in the green, and decidedly surpassed the band in the yellow.

Comet 1884 II:
= Comet *b* 1884.
= Barnard's Comet.

A comet first seen by Barnard, at Nashville, Tenn., on the night of July 16. During the whole period of its visibility (to about November 20) it remained an inconspicuous object. The changes in brightness, as in other comets recently observed, was neither uniform nor consistent with the law of reflected light. The comet was found to move in an elliptic orbit with a period of about 5·4 years, the elements bearing a very close resemblance to those of De Vico's lost comet (1844 I), though the two do not appear to be identical. The spectrum showed two of the cometary bands, the middle one and that in the red; the third was only suspected. This comet perhaps belongs to the fainter class of those revolving in a short period, and this year was probably observed under somewhat favorable circumstances. Perihelion was passed on August 16.

Comet 1884 III:
= Comet *c* 1884.
= Wolf's Comet.

Discovered by Max Wolf, at Heidelberg, on September 17, and independently, with the spectroscope, by Copeland, at Dun Echt, on September 22. The last observation appears to have been by Young, at Princeton, on April 6, 1885. This comet, like the preceding, was moving in an ellipse of short period (6¾ years), and one of the most interesting facts in connection with it was the near approach (about 8,000,000 miles) that it must have made to Jupiter in May, 1875. It seems not at all improbable that from the perturbations experienced at that time, it was brought into its present orbit. Krueger has pointed out that at the returns (consistent with a period of 6¾ years) in 1871 and 1878 the comet was unfavorably situated for observation. In 1864 and again in 1891 the situation is favorable, if we can suppose that it follows the same path as now. During the whole period of its visibility the comet was an insignificant object physically. The spectrum as observed at Nice was continuous, with the three cometary bands. Perihelion was passed on November 17.

Comets of 1885.—During the year 1885 seven comets have been under observation; two were discovered by Barnard, two by Brooks, and one by Fabry, a student at the Paris Observatory. Two of the known periodic comets, Encke's and Tuttle's, were expected to return this year and both were found. Two other periodic comets, Tempel's 1867 II, and Tempel-Swift 1869 III, were also expected, and were carefully looked for; but they were unfavorably situated, and seem to have passed unobserved. A suspicious object, thought to have been Tempel's comet 1867 II, was observed at Geneva in March, but its identity was not fully established.

Comet 1885 I:
=Comet *d* 1884.
=Encke's Comet.

Encke's comet, at this its twenty-third return, was found by Tempel, at Arcetri, on December 13, 1884, close to the place given by Backlund's ephemeris—a faint nebulous mass without any defined nucleus. By the 1st of February a condensation, situated a little eccentrically, as in 1881, was seen, and by the middle of February the faint trace of a tail was visible. Perihelion occurred on March 7. The comet showed quite a bright banded spectrum, while the continuous spectrum of the nucleus was made out only with considerable difficulty.

Comet 1885 II:
=Comet *a* 1885.
=Barnard's Comet.

A telegram was received on July 9, at Harvard College observatory, from Prof. L. Swift, of Rochester, announcing the discovery of a comet by Prof. E. E. Barnard on the evening of July 7, at Vanderbilt University, Nashville, Tenn. The position given was identical with a nebula, No. 4301, of *Herschel's General Catalogue*, and the announcement dispatches were delayed until the fact of the non-identity was established. The comet was seen at Cambridge on the night of July 9. On the 11th of July, as observed by Charlois, at Nice, it consisted of a nucleus of the 105 magnitude, surrounded by a faint, irregular nebulosity about 1′·5 in diameter. Professor Young, observing with the 23-inch refractor at Princeton, describes the comet during July as about three quarters of a minute of arc in diameter, somewhat elongated, and much condensed in the center, though without any true stellar nucleus; no structure of jets or envelopes could be made out. There was, however, a faint, slightly fan-shaped tail from 2′·5 to 4′ long, directed at a position angle of about 35°. Professor Young found the spectrum almost continuous, the usual cometary bands being visible only as three slight intensifications of brightness upon the uniform background. A similar spectrum was observed at Nice. The comet appears to have been seen as late as September 2. Several sets of elements have been computed; the peculiarity of the orbit, its great perihelion distance, being brought out by all. The perihelion distance, (2·5) is greater than in the case of any other comet hitherto computed, excepting the extraordinary one of 1729, which did not approach the sun within four times the earth's mean distance. A conjecture having been expressed by Faye and Krueger that the orbit might be elliptic, Dr. Lamp computed elliptic element, and found a period of eighty-seven hundred years, He remarks, however, that owing to the uncertainty in the single observations employed, his results can hardly be considered as decisive, and the orbit may yet turn out parabolic. The comet passed perihelion in the early part of August, the several orbits thus far computed ranging in this element from August 1 to 9.

Comet 1885 III:
=Comet *c* 1885.
=Brooks's Comet.

Discovered by W. R. Brooks, of Phelps, N. Y., on August 31, 1885, and also, independently, by A. A. Common, at Ealing, on September 4. Professor Pickering, who obtained the first accurate position, September 2, describes the comet as of about the 9th magnitude, with circular nebulosity 2′ in diameter, some central condensation, and no tail. It changed very little from this during the few weeks it was visible. According to Dr. H. Oppenheim's orbit, perihelion was passed on August 10, and the comet steadily decreased in brightness from the time of discovery. The nearest approach to the earth seems to have been about September 25.

Comet 1885 IV:
=Comet *b* 1885.
=Tuttle's Comet.
=Comet 1790 II.
=Comet 1858 I.
=Comet 1871 III.

This comet, originally discovered by Méchain in 1790, and rediscovered by Tuttle in 1858, was found at this return by Perrotin and Charlois at the Nice Observatory on August 8, and was observed on each of the following days to August 13, by Charlois. Owing to the faintness of the comet and its slight elevation above the eastern horizon at sunrise, observation was possible for only ten or fifteen minutes. M. Charlois describes the comet as a white spot, about 2′ in diameter, without any central condensation. On August 10, with exceptionally good atmospheric conditions, he thought the nebulosity was elongated in the direction of the meridian.

Herr Rahts, of Koenigsberg, has taken up the work of Tischler, and has deduced an orbit from the observations of 1853 and 1871–'72, with perturbations by Mercury, Venus, the Earth, Mars, Jupiter, Saturn, and Uranus, to July 11, 1885. He obtains a period of revolution of 13·76 years, with perihelion passage on September 11, 1885.

Comet 1885 V:
=Comet *f* 1885.
=Brooks's Comet.

Discovered by Brooks on December 26, 1885, or more than three weeks after the two following comets. It was also, independently, discovered by Barnard on the evening of December 27, making the third comet found by Barnard in 1885, and the second by Brooks. It is described as circular, about 3′ in diameter, equivalent to a star of the 9th magnitude, and with a strong, eccentrically placed condensation. The provisional elements computed by Chandler and Wendell show that the comet is growing fainter, having passed perihelion on November 29.

Comet 1886. .. (Fabry):
=Comet *d* 1885.
=Fabry's Comet.

Discovered on December 1, 1885, by M. Fabry, a student at the Paris Observatory, where he had been engaged for about three months in a search for new comets, with the equatorial coudé. At the time of discovery the comet presented the appearance of a faint round nebulosity (12th magnitude) about 1′ in diameter, with a small, central, stellar nucleus. On December 9 it was observed to be elongated in the position angle of 87°. According to a calculation of its orbit made by M. Lebeuf, perihelion passage occurs on April 5, 1886. The distance from the Earth decreases till the end of April, when the theoretical brightness will be nearly 500 times as great as on the date of discovery.

Comet 1886... (BARNARD):
= Comet e 1885.
= Banard's Comet.

This comet, the second discovered by Barnard during the year, was foundin the constellation Taurus on December 3, 1885. It is described by Tempel, on December 10, as somewhat brighter than Fabry's comet, small, about equal to a nebula of class II, with a star-like center. Elements and ephemeris thus far published show that the comet is increasing in brightness, and that it does not reach perihelion till May, 1886. Dr. Oppenheim's ephemeris places the maximum brilliancy about May 25, nearly 400 times as bright as at discovery; but its proximity to the sun at this time will detract considerably from its splendor.

Periodic comets due in 1886.—Of the now somewhat numerous list of comets of short period, two will be due at perihelion in the ensuing year: (1) The comet Tempel-Swift, or 1869 III, and 1880 IV, which is likely to return under circumstances that will render observations impracticable, so far at least as a judgment can be formed without actual calculation of the perturbations; (2) Winnecke's comet, last observed in 1875, its track in the heavens near the perihelion passage in December, 1880, not allowing of the comet being seen at that return; the perturbations may be very sensible during the present revolution; neglecting their effect, the mean motion determined by Professor Oppolzer for 1880 would bring the comet to perihelion again about August 24·5 - - - The actual orbit of Winnecke's comet approaches very near to that of the planet Jupiter in heliocentric longitude 110°, at which point the comet arrives seven hundred and twenty days, or 1·97 years, before perihelion passage; the distance between the two orbits is then less than 0·06 of the earth's mean distance from the sun.

It is very possible, however, that the comet which may most interest astronomers in 1886 will be that observed in 1815, and known as Olbers' comet, which, according to the elaborate calculations of Dr. Ginzel, will again arrive at perihelion in December, 1886. The most probable date that can be inferred from the observations of 1815, and the computation of planetary perturbations in the interval, is December 16, but unfortunately the observations did not suffice to determine the mean motion in 1815 with precision, and consequently Ginzel found for the limits of the period of revolution 72·33 and 75·68 years; hence the comet may reach its perihelion many months earlier or later than the date given by calculation.

Extensive sweeping ephemerides have been published, and it may not be too soon to direct attention to a search for the comet at the beginning of the next year, or as soon as the region in which its orbit is projected at the time can be advantageously examined. (*Nature*, October 29, 1885.)

METEORS, AND THE ZODIACAL LIGHT.

Meteor shower of November 27, 1885.—On the evening of November 27 there was a remarkable shower of meteors radiating from Andromeda, and presumably connected with Biela's comet, very nearly two revolutions of which had elapsed since the previous great appearance of these bodies in 1872.

In Europe and Asia the star shower was very remarkable wherever the clouds did not prevent its being seen; in this country it was nearly over before sunset, yet in the early evening the meteors were numerous enough to attract very general attention. It would also appear that showers of meteors were observed from this stream not only on the night of November 27, but also at some places on nights preceding and following.

An adequate discussion of the observations can only be made after all the reports are in. Tolerably complete summaries of the accounts thus far published may be found in *Ciel et Terre*, vol. 6, pp. 451, 491, and *Sirius*, vol. 19, p. 33.

"It will be very interesting to notice in 1898 how far the brilliancy of the display to which we may then look forward will be affected by the comparatively slightly altered position in its orbit of the principal aggregation of meteors, which would seem to be a little behind what would have been the place of the comet."

The zodiacal light.—In October, 1883, Prof. Arthur Searle presented to the American Academy of Arts and Sciences a very valuable paper on the zodiacal light, in which he had collected and reduced on a uniform system the evening observations of all the principal observers. The principal points then brought out were that in all probability the apparent changes in the latitude of the zodiacal light were due mainly, if not entirely, to the effect of atmospheric absorption, and that the method of observation by drawing outlines must be replaced by careful photometric observations if definite knowledge was to be substituted for the vague information we now possess as to the "Gegenschein," the "zodiacal bands," &c.; and Professor Searle concluded with the suggestion that the ordinary meteoric theory would gain greatly in simplicity by the substitution of meteoric dust scattered generally throughout the solar system for the meteoric rings that have been usually imagined. Professor Searle has continued his investigations in a recent memoir, in which he corrects, for the effect of atmospheric absorption, Jones's observations of what the latter called the "stronger light," at the elongation 60°, whether made in the morning or evening. The result of the inquiry is to confirm the view arrived at previously, that atmospheric absorption largely affects the apparent position of the zodiacal light, and Professor Searle again lays stress on the need for photometric observations. Professor Searle concludes that, after correcting for atmospheric absorption, there seems reason to think that the zodiacal light has had, during the present half-century, a more northern latitude near the longitude 180° than near the longitude 0°. He also shows, from a careful study of the distribution of the stars in the Durchmusterung, that upon the meteoric theory of the zodiacal light it is to be expected that a continuous zodiacal band should be present; but the question of its actual visibility is complicated by the slight maxima of stellar density which are situated along those parts of the ecliptic most readily accessible to observation from stations in the northern hemisphere. An interesting result is obtained from an examination of the elements of the 237 asteroids first discovered, from which it would seem that the belt of sky occupied by the projections of the orbits of these asteroids "presents certain peculiarities which correspond to those of the zodiacal light, and suggest the hypothesis that the light may be partly due to minute objects circulating in orbits like those of the smaller planets." (*Nature.*)

THE SUN.

Langley's researches on solar heat.—"The results of the work upon which Professor Langley has been engaged for the last several years have recently been published in a complete form as Volume XV of the Professional Papers of the United States Signal Service. No work more thoroughly aggressive, more calculated to further the progress of science and to render it secure, has been undertaken during late years than that which Professor Langley has carried out, chiefly by means of his ingenious and useful instrument, the bolometer. - - - The first chapter contains the preliminary observations made at Allegheny, from which Professor Langley deduced the value of the solar constant as 2·84 calories, a much larger quantity than that generally accepted hitherto. The observations also showed him that, contrary to the generally received opinion, absorption occurred in the visible portion of the spectrum, particularly in the green and blue, and that it diminished as the extreme infra-red was approached, and convinced him that the labor and expense involved in repeating the observations at the base and at the summit of a lofty mountain would be well repaid by the gain in our knowledge.

"In July, 1881, therefore, Professor Langley started for Mount Whitney, a lofty eminence in the Sierra Nevada of Southern California, over 14,000 feet in height, which seemed to combine all the needed requirements. The second chapter gives an interesting account of the journey to Mount Whitney. Then follow several chapters of results of observations and descriptions of the instruments used. Amongst these were a water pyrheliometer after Pouillet's model, a mercury pyrheliometer, two globe actinometers, a 'solar comparator,' and the spectrobolometer. In Chapter XIV the amount of the atmospheric absorption is shown to be about 40 per cent., or double that usually supposed. Then follow chapters on 'Sky Radiation,' 'Nocturnal Radiation,' &c. Chapter XXI gives a general summary of the results; and the most probable value of the 'solar constant' is given as 3 calories. Three appendices follow, on the reduction of psychrometer observations, the determination of wave-lengths in the invisible prismatic spectrum, and also of the influence of convection currents on thermometer bulbs. The work is illustrated by twenty-one plates, mostly the observation curves of the different instruments, besides a map of the district of Mount Whitney, showing the proposed reservation and a view of the mountain camp.

"The principal results of Professor Langley's work may perhaps be briefly summarized as follows: He has shown that the invisible spectrum beyond the red extends much further than was imagined or believed possible; he has detected cold spaces in this spectrum analogous to the dark absorption bands and lines of the visible spectrum, and has determined their wave-lengths. He has shown that all the old formula for the determination of wave-lengths in the prismatic spectrum failed utterly when carried into the infra-red region. The amount of absorption exercised by the atmosphere has been proved to have been greatly under-estimated; it is at least double what has been usually supposed, and the value of the 'solar constant' has been increased in consequence. Contrary to the theory hitherto universally held, Professor Langley has shown that the infra-red rays do not suffer the most absorption, but the visible rays, and especially those in the green and blue, the transmissibility steadily increasing towards the extreme infra-red. From this it follows that what we call white light is not 'the sum of all radiations,' but that remainder of rays which has been filtered down to us, and the sun, could we see it as it is, would appear of a decided bluish tint. Professor Langley's observations seem also to indicate that at a certain point far in the infra-red, transmissibility through the atmosphere suddenly ceases, and it would seem to follow that the earth heat which fails to be radiated away through the atmosphere must be lower than we have yet examined in any spectrum. The old idea of a 'temperature of space' is rejected, and reasons are given for concluding that the heat we receive from celestial bodies, other than the sun, is practically *nil*. Finally, Professor Langley concludes that the temperature of the earth under direct sunshine, even though our atmosphere were present as now, would probably fall to 200° C. if that atmosphere did not possess the quality of selective absorption. To this catalogue of results may be added that the volume before us gives abundant evidence of the attention and care which Professor Langley has given to free his work from every source of error." (*Observatory*, September, 1885, p. 309.)

We can only refer by title here to a lecture on "Sunlight and the earth's atmosphere," delivered by Professor Langley at the Royal Institute, April 17, 1885, a full report of which has appeared in *Nature* (vol. 32, p. 17, 40), and to his interesting and admirably illustrated astronomical articles on "The New Astronomy," in the *Century* for September, October, and December, 1884, and March, 1885.

Diameters of the sun and moon as observed with the Greenwich transit circle (W. G. Thackery).—The author considers the values of the diameters of the sun and moon furnished each year by the result of all the observations, and also the values resulting each year from the work of the individual observers. The following results were found for the sun, with which are given the results obtained by Sir G. B. Airy, in a paper entitled "On the Circularity of the Sun" (*Monthly Notices*, vol. XXII):

Period.	No. of obsns.	Hor. Diam.	No. of obsns.	Vert. Diam.	Authority.
		′ ″		′ ″	
1853 to 1860	795	32 2·65	851	32 2·61	Airy.
1861 to 1883	2,185	32 2·28	2,317	32 2·62	Thackeray.

The difference in the values of the horizontal diameter is rather surprising when compared to the identity of the values of the vertical diameter; but the personal equation must be taken into account in considering the observations, the following table showing its importance:

Tabular errors of the sun's vertical diameter, according to different observers.

Observer.	Tabular error.	No. of obsns.
	″	
Dunkin	+2·28	138
Ellis	—0·19	269
J. Carpenter	+3·13	191
Criswick	+1·65	347
Lynn	—1·59	149
Downing	+1·70	203
Thackeray	+1·01	141
Lewis	+0·48	72
Hollis	+0·15	44

The observations extend from 1861 to 1883. The error as found by one observer often varies with the time. As to the horizontal diameter found by the transits of the two limbs, the following results have been given by Mr. Dunkin in Vol. XXXV of the *Monthly Notices*, p. 91, for the period 1864 to 1873:

Tabular errors of the horizontal diameter.

Observer.	Tabular error.
	″
Dunkin	+0.87
Ellis	+1.48
Criswick	+0.31
Lynn	+1.05
J. Carpenter	+2.45

Mr. Thackeray has also considered the observations of the moon's diameter. In this case the personal equation is almost insensible, and the correction to the *Nautical Almanac* is unimportant.

One result of the preceding discussion is to show that it would be proper in reducing incomplete observations of the sun (observations of one limb only) not to adopt a uniform value for the diameter, but to employ the observer's own value. (*Bull. Astron.*, August, 1885.)

List of eclipses.—Dr. Theodore von Oppolzer, of Vienna, announces the early publication of a very extended list of the dates of solar and lunar eclipses which has been prepared under his direction. There will be eight thousand of the former and more than five thousand of the latter class of phenomena, and all included between the years 1207 B. C. and 2161 A. D. In publishing the hours of the day at which the eclipses will occur, Dr. Oppolzer will adopt the new reckoning of astronomical time recommended by the International Prime Meridian Conference at Washington in 1884, thus making this publication the first astronomical work of importance in which this method of counting the hours of the day is adopted.

Eclipse of the sun, 1869, *August* 7.—The report of observations of the total eclipse of the sun of August 7, 1869, made by parties under the direction of Prof. J. H. C. Coffin, superintendent of the American Ephemeris and Nautical Almanac, has been published during the year, the delay in the appearance of the volume being due to the illness of Professor Coffin. The results of the work of Professors Young, Gould, Pickering, Morton, and others have already been known through other channels, but many valuable details are now given for the first time. Ten plates accompany the work, among them some excellent engravings from the photographs at totality.

Eclipse of the sun, 1885, *March* 16.—This was visible as a partial eclipse throughout the United States, and as an "annular" eclipse in the northwestern part; the annulus describing a path about 75 miles wide, across Montana, Idaho, and the northwestern part of California.

A circular was sent out by the Superintendent of the Naval Observatory stating that time signals would be sent to observers along this line, and requesting that observations of the beginning and ending of the eclipse and of the annular phase should be transmitted to the observatory. Reports were received from sixteen observers, and many of these reports, together with an account of observations made at the Naval Observatory, embracing observations of contact, observations made with the transit instrument and transit circle, and results from photographs made with the transit of Venus photo-heliograph, are published as Apendix II to the Washington observations for 1882.

Observations of contact were made by Professor Peters at Clinton, and photographs were taken at the Chicago and Lick Observatories. Mr. Charles H. Rockwell observed the annular phase from Delta, Cal.

Eclipse of the sun, 1885, *September* 9.—The track of the line of total eclipse lay almost wholly in the South Pacific Ocean, the only land on which the total phase was observable being the shores of Cook's Straits, New Zealand. The duration of totality was about two minutes at the point most favorably located. "It would appear that no central eclipse has traversed these islands during the present century; an examination of the various ephemerides points to the annular eclipse of December 29, 1796, as the last which was there central. An annular, though nearly total, eclipse will take place near the north extremity of the North Island on January 3, 1927, while on May 30, 1965, when the sun is barely risen to an altitude of 5°, he will be totally eclipsed on the east coast of the North Island, near its north extremity, for about $2^m\ 20^s$."

From the reports we have seen it would appear that many of the parties which were organized for the purpose of observing the expected phenomena were seriously interfered with by bad weather. At Tahoraite, a point well within the belt of totality but some 40 miles north of the central line, Mr. Graydon succeeded in obtaining five sketches during totality; these sketches show five or six long rays (besides a large number of shorter ones) projecting from the sun's limb, the longest ray being some two or three diameters of that body in length. A dark rift was observed in the corona, and near this rift a red flame was noticed by some of the bystanders to shoot out just before the end of totality. Photographs were obtained at Blenheim, at Masterton and at Nelson; and other observations were made at Wellington, Dryertown, and Palmerston.

Eclipse of the sun, 1886, *August* 28–29*.—The eclipse of August 28–29, 1886, will be total only in the torrid zone, and the path of the total phase will fall mainly in the open Atlantic Ocean, but at Benguela, on the western coast of South Africa, it will be observable at about 3 o'clock of local time in the afternoon. It will be remembered that this eclipse is of rather more than ordinary interest on account of the long duration of totality, $4^m\ 41^s$, near Benguela. Another interesting circumstance has been noticed by Dr. Herz, of Vienna, in the fact that at totality two stars, 47 ρ Leonis and 49 Leonis, are close to the sun, the latter within the corona. It is suggested that by means of measurements upon these two stars, something may be learned in regard to the refracting power of this peculiar atmosphere of the sun. A bill is now pending before Congress, appropriating $10,000 to enable the Secretary of the Navy to fit out an expedition to observe this eclipse.

Transit of Venus.—From Professor Harkness's† report to the president of the American Transit of Venus Commission, we make the following extract:

"At the date of my last annual report experiments were in progress to determine whether or not the heliostat mirrors undergo any change of curvature when exposed to the sun's rays. As that question is of vital importance in the theory of the horizontal photo-heliograph, it was thought desirable to make the experiments both in the heat of summer and in the cold of winter. The work was completed on February 23, 1885.

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* See, also, Account of Progress of Astronomy, 1883, Smithsonian report, p. 391.

† See Report of Superintendent U. S. Naval Observatory, 1885, p. 12.

"Mr. Rogers is now engaged in writing an account both of the processes employed in preparing and developing the dry collodion emulsion plates used with the photo-heliographs in observing the transit of Venus in December, 1882, and of the experiments which were executed to determine the best method of making pyroxyline for that purpose. Whenever photographs are required which must sustain the test of accurate measurement, the collodion emulsion process offers advantages so great that every effort should be put forth to increase its general availability. Some of our recent experiments incidentally tend in that direction, and although primarily made to clear up obscure points relating to the transit of Venus work, it is hoped they will facilitate the application of collodion emulsion in future operations requiring the use of photo-heliographs. In these experiments pyroxyline has been made from flax, jute, etc., as well as from cotton, which is the form of cellulose commonly preferred.

"It will be remembered that wet bromo-iodide plates, made by the bath process, were used with the photo-heliographs in observing the transit of Venus in December, 1874, and the question naturally arises whether or not the negatives then obtained are strictly comparable with those made upon dry collodion emulsion during the transit of December, 1882. For the definite settlement of that point recourse was had to photographs of the solar spectrum. In June, 1881, a set of such photographs was made upon wet bromo-iodide bath plates of the kind used in December, 1874, and similar sets are now being made with emulsions as nearly as possible in the same condition with respect to age, etc., as those actually employed in observing the transit of December, 1882. In order to show clearly the progressive action of the solar rays upon the silver salts, each set begins with the shortest exposure capable of producing an easily legible impression, and extends to exposures two or three hundred times as great. The negatives have not yet been subjected to critical examination, but the general result seems to be that, while marked differences exist in the action of the spectrum upon the two classes of plates with the exposures given in the photo-heliographs, the effective rays are of substantially the same wave-length in both. The transit plates of 1874 and 1882 are therefore quite comparable in this respect, and there is no reason to apprehend systematic differences between them depending upon atmospheric dispersion. The spectrum photographs have also established the fact that the emulsion plates have a degree of sensitiveness not very different from that of bath wet plates."

The reduction of observations for time and latitude made at the various United States stations in December, 1882, are now nearly completed and to a considerable extent prepared for printing. It is expected that they will form Part III of the Transit of Venus Reports. No progress has been made in the reduction of the photographs during the current year, and it is not proposed to take them up again until after all the manuscript relating to time, latitude, and longitude has been prepared for the printer.

The work of printing Part II of the Transit of Venus Reports has recently been resumed, and will probably be completed at an early date. This part will form a volume of about five hundred quarto pages, and will contain the records of all observations made at the United States stations for observing the transit of 1874, together with the corresponding reductions and discussions, excepting only those relating to the photographs.

The French photographs of the transit of Venus.—The measurement of the seven hundred photographs obtained at the various French stations during the transit of Venus, 1882, is about to be commenced. An office has been organized for the purpose, the necessary credit has been granted, and a measuring instrument belonging to the Meudon Observatory and lent by M. Janssen, has been supplied. This will be replaced in January, 1886, by a smaller one by the same makers, MM. Brunner Frères. The measurements, it is expected, will be completed in fifteen months.

Photographic evidence as to the constitution of sun spots.—"M. Janssen, remarking on some exquisite photographs of sun spots which he has obtained during the past year, calls attention to the evidence they supply as to the continuation of the granulation of the general solar surface, into the spots. A photograph of the great spot of 1885, June 22, for example, to which he particularly alludes, shows that the bright region which surrounds the penumbræ of large spots has not a different constitution from that of the photosphere in general, since it is made up in like manner of granular elements, usually of a spherical form. The marked increase in brightness of such regions the photographs show to be due to the granulations being more thickly clustered, brighter in themselves, and arranged on a brighter background. In the penumbra the granulations are still distinguishable, but they are less luminous and more scattered, leaving dark gaps between the rows of grains, the familiar striated appearance of the penumbra being due to the arrangement of the granulations in ranks and lines, like beads on a thread. The grains become in general smaller and duller near the nucleus, where they seem to dissolve. The same spot presented two very remarkable bridges, and a very bright isolated mass of luminous matter which united them. This luminous matter and the bridges were also formed of granular elements resembling the others. Many other photographs have revealed a similar structure in penumbræ and their surroundings, so that it is highly probable that 'the luminous matter which forms the solar surface has everywhere the same constitution.'" (*Nature*, February 4, 1886.)

Sun-spot maximum.—The exact epoch of the last sun-spot maximum, which for some time remained in uncertainty, has been placed by Wolf at 1883·9, and his result has been confirmed* by the observations of the past year. The previous maximum was well marked at 1870·6 and, with the 11-year period (more exactly 11·1 years) the next was expected at 1881·7 or the beginning of 1882; and in fact in April, 1882, a "false" maximum did occur, but with the finally established maximum at 1883·9 we have a retardation of about two years. The interval from the preceding maximum is therefore 13.3 years, and from the preceding minimum of 1879·0, 4·9 years. It is quite remarkable also that the variations of the magnetic needle have shown a similar anomalous fluctuation.

The Solar Corona† (*a lecture delivered at the Royal Institution, by* Dr. Huggins, *February* 20, 1884).—"After mentioning the various hypotheses concerning the nature of the corona (a gaseous atmosphere, fine particles ejected by the sun and in motion around the sun caused by several forces, one of them being perhaps the repulsive force observed in the case of comets, a center of meteoric streams, etc.), Dr. Huggins speaks of Dr. Hastings's new theory, according to which the corona is not a reality but simply a phenomenon caused by diffraction. Without dwelling upon the proof of its reality furnished by photographs made when there was no eclipse, and consequently no intervention of the moon, Mr. Huggins finds that the analysis of the spectra of different parts of the corona and the peculiar structure seen in the photographs taken during eclipses contradict Dr. Hastings's theory. If Dr. Hastings's theory were correct the corona would of necessity change during the course of the eclipse and the photographs reveal no change. M. Janssen says: 'Les formes de la couronne ont été absolument fixes pendant toute la durée de la totalité.'

"The sun is doubtless surrounded by a gaseous atmosphere of a certain extent, but there are a number of reasons why the corona should not be regarded as a prolongation of this atmosphere. A gas even a hundred or a thousand times lighter than hydrogen at the height of the corona would, at the sun's surface, be heavier than metals,—a state of things which spectroscopic and other observations show cannot be the true one. The corona does not show either that rapid condensation towards the sun which an atmosphere would show, especially if we take into account the effect of perspective in increasing the brightness of the lower parts of the corona. Moreover, comets have been known to pass through the upper part of the corona without losing either matter or velocity.

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* Sur le statistique solaire de l'année 1885. *Compt. Rend.* 102: 161.

† See The Observatory, vol. 8, p. 153.

"There can be no doubt that the corona shows us matter existing about the sun in the form of a fog, of which we may form some idea by imagining the air we breathe very much rarefied but still full of particles rendered visible by a sun's ray. The matter of the corona sends us three kinds of light: Solar light dispersed by particles of matter, either solid or liquid; light giving a continuous spectrum, showing that the solid or liquid particles are incandescent, and light giving spectra of brilliant lines, fainter and varying greatly at different parts of the corona and at different eclipses, which must be due to the presence of a luminous gas. This gas existing between the particles does not form a solar atmosphere in the true sense of the word (such an atmosphere has already been shown to be impossible), but this gas may be regarded as carried along by the particles; it is due perhaps to the heat of the sun.

"Comets show characteristics which are not without analogy to those of the corona; in the case of comets we see reproduced on a small scale the luminous streams, the rifts and curved rays.* We do not know the conditions under which these cometary appearances occur, but the generally accepted hypothesis attributes them to electrical action, and especially to a repulsive force acting from the sun, and doubtless an electrical force, which varies with the surface, and not, like gravity, with the mass. A force of this nature could easily overcome the force of gravity, and, as we see in the tails of comets, drive very much rarefied matter to immense distances. Such a repulsive force, if electrical in its origin, must act between bodies charged with the same kind of electricity, and according to this theory the material of which the corona is composed and the surface of the sun must be in the same electrical state; a certain permanence of the same electrical state would seem to be required by the phenomena of the tails of comets; but we are quite in ignorance on this subject.

"However this may be, it is quite in conformity with the ideas expressed above, that the positions of greatest coronal extension should usually correspond with the spot zones where the solar activity is greatest. A careful investigation of the structure of the corona leads us to think also that the forces to which this complicated and variable structure is due have their seat in the sun. Matter repelled by the sun would participate in the rotary velocity of the photosphere, and lagging behind give rise to curved forms. Moreover, the force of the projection and the subsequent electrical repulsion might very well vary in direction and not be always strictly radial, and this would help to explain the character of the corona. The relative permanency of some of the coronal forms during several weeks does not imply that the matter is immovable; flames over the mouths of volcanoes often offer a similar appearance. If the forces to which the corona is due reside in the sun, the corona ought, of course, to revolve with it; but if the corona is produced by causes extraneous to the sun, it may be otherwise.

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*See "Comets," *Royal Institution Proceedings*, Vol. x, p. 1.

"We have seen that the corona probably consists of an incandescent fog, which, at the same time, sends us by reflection the light of the photosphere. Now we must remember that there is a great difference in the behavior of a gas and of liquid and solid particles in the immediate vicinity of the sun. A gas need not be greatly heated even when near the sun by the radiated energy; when once heated it would rapidly lose its heat when above the photosphere; but solid and liquid particles, whether carried up as such or having become such by condensation, would absorb the sun's heat and at the distance of the corona would reach a temperature but little inferior to that of the photosphere. The gas shown by the spectroscope to exist among the incandescent matter of the corona may therefore have been carried there as gas or may have been in part distilled from the coronal particles under the influence of the enormous solar radiations. There would be no discordance between this theory and the fact of the very different heights at which the brilliant lines in the corona have been observed. Gases of unequal densities, unequally repelled by a repulsive force varying as the surface, would be to a certain degree separated, the highest gas being most influenced by the repulsive force, the heaviest being most influenced by gravity. The relative proportions at different heights of the corona of the gases, whose presence is shown by the spectroscope, vary from time to time and depend in part upon the state of activity of the photosphere in such a way as to establish a probable connection with the spectrum of the protuberances. (Captain Abney and Professor Schuster have recently shown that beside the bright lines already known, the spectrum of the corona of 1882 gave the group of the ultraviolet lines of hydrogen, which are characteristic of the photographic spectra of white stars, and other lines also.) In this view of the corona, therefore, we find a new example of such relations as those existing between the phenomena of sun spots and magnetic perturbations or auroræ.

"Many questions are left unconsidered, this among others, whether the light emitted by the gaseous part of the corona is due directly to the sun's heat or to electrical discharges of the nature of the aurora. Further, what becomes of the coronal matter on the theory which has been suggested? Is it permanently carried away from the sun as the matter of the tails of comets is lost to them? Electric repulsion can continue only so long as the repelled particles remain in the same electrical state. If the electrical state changes, the repulsion must cease, and, gravity no longer counteracted, the particle must fall back to the sun. In Mr. Wesley's drawings of the corona, especially in those of the eclipse of 1871, the longer rays or streamers seem not to end but to be lost in the fainter parts of the drawing; but some of the shorter ones seem to turn and descend to the sun.*

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* Concerning the nature of the corona consult the papers of Norton, Young, and Langley in the *American Journal of Science*, *The Sun*, by Professor Young, and various essays by Mr. R. A. Proctor.

"It is difficult for us living in dense air to conceive of the state of attenuation probably present in the outer parts of the corona. Mr. Crookes has shown by experiment that matter reduced to one-millionth part of the density of ordinary air is still possessed of a sufficient number of molecules to display a perfect corona when under the influence of an electric current. In any case we may hope that our present knowledge on the subject will be much increased by the daily photographs of the corona, which are about to be commenced at the Cape by Mr. Ray Woods under the direction of Dr. Gill." (*Bull. Astron.*, June, 1885.)

Professor Young on the solar corona.—In an article on "Theories regarding the sun's corona," in the *North American Review*, Professor Young expresses "his complete conviction that the corona is mainly solar." He points out that the corona sends us three kinds of light, the spectroscopic evidence showing that reflected or diffused sunlight is present, though not the main constituent of the coronal luminosity, the continuous spectrum indicating the presence of incandescent particles, solid or liquid, whilst the bright lines show the presence of luminous gases. These mingled gases form what has been called the "coronal atmosphere," but in it "there are filaments and streamers and other forms that are probably not gaseous, but composed of mist and dust; some of them may be of meteoric origin, and some composed of matter ejected from the sun, while others perhaps are due to condensation of vapors." The analogy of the channels in the tails of comets to the coronal rifts, and the evidence comets afford to a repulsive force exercised by the sun, strike Professor Young as they do Dr. Huggins: "All the luminous phenomena of the corona could be accounted for by an atmosphere of a density millions of times below that in any vacuum-tube ever constructed."

Photographing the corona in full sunshine.—Mr. W. H. Pickering, of the Institute of Technology, Boston, made a series of attempts during the partial eclipse of March 16, 1885, to obtain a photograph of the corona. In this he was quite unsuccessful, for though his plates showed several corona-like markings, they were clearly not due to the true corona, as they were found in front of the moon as well as on the sun's limb. From this Mr. Pickering was evidently led to conclude that the results which Dr. Huggins had obtained were probably of a similar character, and he expressed as much in a letter to *Science*. Dr. Huggins in reply pointed out that Mr. Pickering's method was faulty and was calculated to produce such false images. The latter, therefore, somewhat modified his apparatus without, however, altering the two points which Dr. Huggins considered most erroneous, viz, the use of an object-glass instead of a reflector, and the placing his drop-slit close in front of the object-glass instead of in its primary focus. The result has been that he has obtained photographs free from false coronæ, but showing no real ones. At the same time he has made experiments which convince him that to produce a perceptible image of a coronal rift it is necessary to be able to discriminate between degrees of illumination which do not differ from each other by more than one-tenth the intrinsic brilliancy of the full moon. He considers that the eye is more able to detect small differences of light than a photograph is, and states that the moon cannot be photographed in full daylight, even though it may be easily seen. His investigations also lead him to think that even in the clearest weather the atmospheric illumination is three hundred times as bright as it should be for it to be possible to obtain any image of the corona. To these points Dr. Huggins has replied in the *Observatory* for November. Dr. Huggins states that he has had no difficulty at all in photographing the moon in full sunshine, and that the observations of Professor Langley and others, of Mercury and Venus, which have been seen as black disks before they reach the sun, proves that the corona must have a sensible brightness as compared with the atmospheric illumination.

He also points out that Mr. Pickering fails to obtain any trace on his photographs even of the detects of his own instrument. Dr. Huggins declines further discussion, preferring to wait the result of the work now being carried on by Mr. Ray Woods at the Cape Observatory. Mr. Pickering replies in *Science* for October 23, admitting the possibility of photographing the moon in full sunshine, but contending that these very photographs of the moon supply an additional proof of his opinion that the light of the atmosphere near the sun is more than three hundred times too intense for it to be possible to obtain a photograph of the corona, since the skylight near the sun was fifty times as bright as that near the moon, and coronal photographs to be of any use should be able to record differences of illumination of only one-tenth the brightness of the full moon.

He explains the visibility of Venus and Mercury as being caused by the refraction of the sun's light through their atmospheres, the black disk being thus surrounded by a narrow luminous ring. (*Nature.*)

Remarkable solar prominences. *—On the 26th of June, 1885, a remarkable prominence was noticed upon the eastern limb of the sun by M. Trouvelot, of the Meudon Observatory. Its measured height was about 10′·5, or about a third of the sun's diameter, but it probably extended somewhat further. At a point on the sun's limb diametrically opposite, another immense prominence was seen nearly equal in height to the first. A somewhat similar phenomenon—two opposite prominences—had been observed on November 22, 1884.

On August 16, 1885, at $9^h\ 25^m$, M. Trouvelot observed a brilliant prominence 4′ in height, which by $11^h\ 20^m$ had increased to 9′ 27″. With the increase in height, it diminished rapidly in brightness, and at $11^h\ 22^m$ had completely disappeared.

Peculiar prominences were also remarked by M. Ricco, of the Palermo Observatory, September 16–19, and by M. Trouvelot on September 27.

L'Astronomie, 4 : 441–7.

Rowland's photograph of the normal solar spectrum.—This map has been made by Professor Rowland of the Johns Hopkins University, with one of his concave gratings of 21½ feet radius of curvature and 6 inches diameter, and is now complete from wave-length 3680 to 5790; the portion above 3680 to the extremity of the ultra-violet, wave-length about 3100, is nearly ready. Negatives have also been prepared down to and includign *B*, and it is possible they may be prepared for publication; a scale of wave-lengths has been added. "The error in the wave-length at no part exceeds $\frac{1}{50000}$ of the whole, and is generally caused by a slight displacement of the scale, which is easily corrected. The wave-lengths of more than 200 lines in the spectrum have been accurately determined to about $\frac{1}{500000}$ part, and these can serve as standards to correct any small error of the scale. - - - The 1474 line is widely double, as also b_3 and b_4, while *E* is given so nearly double as to be recognized as such by all persons familiar with spectrum observation. Above the green the superiority increases very quickly, so that at *H* we have 120 lines between *H* and *K*, while the original negatives show 150 lines. The photographs show more at this point than the excellent map of Lockyer of this region."

THE PLANETS.

INTRA-MERCURIAL PLANET.—The report* of a committee of the National Academy of Sciences, to which was referred the question of the expediency of fitting out an expedition to the west coast of Africa for the purpose of observing the total eclipse of the sun on August 28–29, 1886, contains the following remarks in regard to the hypothetical planet revolving within the orbit of Mercury: "In addition to the observation of the sun itself, and the luminous phenomena attending it, it is desirable to obtain photographic maps of all the surrounding region to the distance of at least ten or fifteen degrees from the sun, for the purpose of finally setting at rest the still mooted question of an intra-mercurial planet. It is true that the astronomical world is at present disposed generally to discredit the existence of such a body, yet the evidence on the subject up to this time is mainly negative, as it must always continue to be so long as it depends upon direct vision. In a photographic map, taken during total eclipse of the sun, of the whole region within which such a planet must necessarily be confined, the object, if present, must present itself, and could not fail to be recognized. But for photographic operations of this class, lenses of wide angle must be specially prepared, differing essentially in character from those which are employed to take impressions of the eclipse."

A search for the "supposititious Vulcan" was again made by Mr. T. W. Backhouse, of Sunderland, England, in March and April, 1885—the period during which a transit is possible, according to Leverrier—but with no positive result. Mr. Backhouse says: "I consider the question of the existence of Vulcan can only be settled by continued and *systematic* watching for its appearance in transit, as at the time of an eclipse of the sun it may be too near that luminary to be visible."

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* Senate Ex. Doc. No. 67, Forty-ninth Congress, first session.

The EARTH: *Variability of terrestrial latitudes.*—The question of the variability of terrestrial latitudes was brought anew to the attention of astronomers by the International Geodetic Conference at Rome in October, 1883. A plan for settling the question by observation was proposed by M. Fergola, an Italian astronomer, which was, essentially, that a careful series of observations should be made with prime vertical instrument, by two co-operating observatories differing but little in latitude, though, perhaps, considerably in longitude. The same list of stars was to be used at each pair of such stations. By repeating these observations after an interval of fifty years or more, the question of the variability of latitudes would be subjected to a severe test. Theoretically, periodical changes of latitude may occur, and an examination of observations made at a number of Northern observatories during the past seventy-five years—Königsberg, Milan, Naples, Paris, Pulkowa, and Washington—appears to confirm the existence of such changes. At Pulkowa, which furnishes the most careful series of observations, a diminution of the latitude of $0''\cdot23$, equivalent to about 23 feet, is indicated between the years 1843 and 1872; but in all these cases the variations are small, and we must be extremely cautious in ascribing them to actual changes of latitude. A recent and very complete discussion of the latitude of the Greenwich Observatory by Mr. Christie gives no evidence of a secular change of latitude, and a later determination of the latitude of the Washington Observatory (in 1883) also furnishes no proof of a change.

Prof. Asaph Hall, in a paper* read before the Philosophical Society of Washington, February 28, 1884, has given a discussion of the observations tabulated by M. Fergola. His conclusion is that "observations do not prove that latitudes are variable, and the evidence points rather to other sources of small changes that may depend on the seasons. Perhaps some of these may arise from the tables of refraction which are in common use, and which are assumed to fit the whole earth."

Some preliminary steps have been taken towards putting Fergola's plan in operation at the observatories of Lisbon and Washington (the difference of latitude being $11'\ 7''$), but we believe no observations have actually been made yet.

Effect on the earth's motion produced by small bodies passing near it.—Professor Newton points out† that the space through which the earth travels is traversed also by small bodies, or meteoroids. The impact of these bodies upon the earth, and the consequent increase of the earth's mass, have their effect upon the earth's motions, both of rotation and

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*[*Amer. J. Sci.*, 3 s. vol. 29, p. 223–27; also *Observatory* 8, p. 113–17.

†*Amer. J. Sci.*, December, 1885, 3 s., vol. 30, p. 410–17.

revolution, and hence upon the lengths of the day and year. Professor Oppolzer (*Astron., Nachr.*, 2573) has discussed the amount of these actions, and has computed the density which the meteoroid matter must have in order to produce the observed and unexplained acceleration of the moon's mean motion. But a body that passes near to the earth has also an action of like character due to the attraction of gravitation alone, and Professor Newton proceeds to calculate its amount. The conclusion at which he arrives is that the effect upon the earth's motion of the meteors that come into the earth's atmosphere exceeds at least one hundred fold that of the meteors that pass by without impact. (*Observatory.*)

Determination of longitudes in South America.—According to *Science* (vol. v, p. 151), Commander Davis has just completed his important telegraphic determinations of longitude on the western coast of South America. The great chain connecting Washington with different points in South America, and then extending through Saint Vincent, Madeira, Lisbon and Greenwich, is now closed with but an insignificant discrepancy.

The proposed change in the beginning of the astronomical day.—No general agreement has been reached by astronomers upon the sixth resolution of the Washington Meridian Conference, which recommends that the astronomical and nautical days be arranged everywhere to begin at mean midnight. The matter was brought up at the Geneva meeting of the *Astronomische Gesellschaft* in 1885. (See *Vrtljhrschr.*, 20, p. 227–31.) Struve, Folie, and Pechüle seemed to be the only members present in favor of the change, while Newcomb, Weiss, Krueger, Dunér, Auwers, Tietjen, and Safarik spoke in opposition to it. Mr. Downing, of the Greenwich Observatory, says (*Nature*, 32 : 353), " - - - and judging from the individual expressions of opinion that have been published, I should imagine that here, as at Geneva, the majority of real workers in our science (with the probable exception of those engaged in solar work) would be opposed to the proposed change."

In the United States, official action has been taken by the Secretary of the Navy, referring the question to the National Academy. The report (Senate Ex. Doc. No. 67, Forty-ninth Congress, first session) of a committee of that body consisting of Pres. F. A. P. Barnard, Profs. A. Graham Bell, J. D. Dana, S. P. Langley, Col. Theodore Lyman, Profs. E. C. Pickering, and C. A. Young says: "The committee regard favorably the proposition of the meridian conference on this subject, and recommend that the change should be made as soon as sufficient concert of action can be secured among the leading astronomers and astronomical establishments of the civilized world—in 1890, if practicable; if not, in 1900."

It would seem to be incumbent on those astronomers who have expressed themselves in favor of the proposed change, and of the consequent interruption of astronomical chronology, to justify strongly their position. It is not quite clear that this has been done, for while many reasons are given *against* the change, almost the only argument in its favor (besides that of convenience in solar work) is, that there will be established a certain uniformity of time-reckoning between astronomers and the world at large.

In addition to the references given above, we should call attention to the following papers upon this important question:

Ball (R. S.). Proposed change in the astronomical day. *Observatory*, 9 : 100.

Fleming (S.). Universal or cosmic time. Toronto [1885].

Foerster (W.). Ueber die von der conferenz zu Washington proponirte Veränderung des astronomischen Tagesanfanges. *Astron. Nachr.* 111 : 33–8.

Letter from the Secretary of the Navy transmitting communications concerning the proposed change in the time for beginning the astronomical day [from the superintendent of the Naval Observatory, the superintendent of the Nautical Almanac, and various American astronomers]. Senate Ex. Doc. No. 78, Forty-eighth Congress, second session.

Newcomb (S.). On the proposed change of the astronomical day. *Month. Not. Roy. Astron. Soc.*, 45 : 122.

von Oppolzer (Th.) On the proposed change of the astronomical day. *Month. Not. Roy. Astron. Soc.*, 45 : 295–8.

Struve (O.). Die Beschlüsse der Washingtoner Meridianconferenz. St. Petersburg, 1885. 27 p. 8vo.

"*Sky-glows: Certain phenomena in meteorological optics that have occurred since the close of the year* 1883. *Hypothesis concerning the cause and origin of these phenomena.*—The immediate cause of the "red sunsets" seems to be the existence at a very great height in the atmosphere of a cloud, or rather a light mist, composed of very fine particles. This hypothesis would explain the twilight phenomena when the sun was 18° or 20° below the horizon. We need not suppose these particles to have had a greater altitude than 60 or 70 kilometers during the first of these apparitions.

"The red color of these lights corresponds very well with the absorptive power of the atmosphere which physicists observe in the sun's radiations at different altitudes and astronomers in the ruddy tint presented by the moon's disk in total eclipses;* the distance traversed through the atmosphere by the sun's rays before reaching this cloud explains sufficiently the intensity of the coloring.

"The solar corona and the anti-solar aureole could be easily explained with this hypothesis if the particles held in suspension in the atmosphere are supposed to offer a sensibly constant mean diameter, as the theoretical conditions for diffraction coronas would then be present.

"The next question is, What is the origin of these particles suspended in the atmosphere? The reply to this question is quite independent of the explanation of the phenomena of meteorological optics presented above. There have been a number of hypotheses on this subject. The first, seeking an explanation in the ordinary domain of meteorological influences, gives as the origin of these particles the formation of very minute ice crystals like those which appear to constitute the cirrus clouds. The trouble with this very simple hypotheses is that so many additional hypotheses are required to sustain it. For some hypothesis must be made as to the cause of the production of frozen clouds at an unusual altitude. Some reason must be assigned for their permanence during months and even years. And the question why optical phenomena, halos, mock suns, &c., which accompany the ordinary existence of ice crystals in the atmosphere do not appear permanently must be answered.

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* The total eclipse of the moon October 4, 1884, did not show this red color in the usual degree. This is regarded by some as a proof of the existence of these clouds of particles, the higher regions of the atmosphere being rendered less transparent by their presence.

"Although it might be possible to find explanations for all these points of difficulty, it is evident that the proposed hypothesis is simple in appearance only, and that it meets with difficulties rather than with confirmations in the observed facts.

"The second hypothesis attributes to these particles a cosmic origin, that is to say, the same origin as is assigned to meteors; the earth is supposed to have passed in its orbital motion through a cloud of small particles, revolving, like herself, about the sun, and to have drawn after her all the particles within her sphere of attraction. This hypothesis seems at first thought a very satisfactory one; the twilight lights, at first so brilliant, have been growing fainter. This accords with the idea that the particles have come from some external source, and have by degrees fallen, in the order of their size, to the earth's surface. The explanation appears all the more plausible since true rains of dust have been observed in different countries. Nordenskjöld made a chemical examination of a sample of this dust, collected in Sweden, and found it to contain iron and nickel, elements that are present in meteorites. Still, this argument is not decisive, for rains of dust, whose origin is certainly terrestrial, have often been observed; as, for example, the dry fogs, well known in southern Europe, composed of mineral dust brought by the wind across the Mediterranean from the desert of Sahara. This dust has been collected at sea by sailors, and also on the coasts, and has been found to contain silica, feldspar, and mica, elements of the sands of the African desert.

"Volcanic ashes have been sometimes found in Norway, coming from the eruptions of Iceland volcanoes; the microscope shows these to contain fragments of pumice and even crystals of pyroxene. The cosmic origin of these particles must therefore be sustained by more direct proofs, if it is to be accepted.

"The third hypothesis connects the diffusion of these clouds of particles with the frightful cataclysm at Java, when 50,000 persons lost their lives through the explosion of Krakatoa. Nearly all the arguments employed by the partisans of the cosmic origin apply with equal force to this volcanic origin. It explains why the first twilight manifestations appeared directly after the eruption at Java, nothing of the kind having been observed before; it explains, moreover, the progressive march of the apparition of these lights about the center of explosion. This progressive march renders the cosmic origin of these particles quite improbable, for in case of a cosmic origin there seems to be no reason why the phenomenon should not appear nearly simultaneously at all points on the earth's surface. Those regions on the Indian Ocean forming the trajectory of a cyclone show in a convincing manner that the ashes of the Java volcano, caught up by the ordinary winds of that quarter, are the cause of the extraordinary sunsets in question.

"The objection may be raised that the height of these particles is very great in comparison to the height to which the smoke of our European volcanoes rises; but, after reading M. Verbeck's report, these objections disappear before the greatness of this volcanic convulsion. A quantity of matter, whose volume was estimated at 150 cubic kilometers, was seen projected 18 or 20 kilometers above the crater. When we think that the gaseous matter that escaped at the same time must represent a volume some hundreds of times as great, we cease to be astonished at the thought of the diffuse dust reaching an altitude of 70 or 80 kilometers. As to the suspension of these particles in the air, it at least does not contradict what we know of the laws of the air's viscosity, nor of the action of winds, heat, and atmospheric electricity.

"A more detailed discussion of the documents published on the subject of this frightful explosion would carry us beyond the scope of this simple article; enough has been said to show that these optical phenomena, of which our atmosphere has been for some eighteen months and is still the scene, may be referred with great probability if not certainty to a volcanic origin." (Cornu, in *Bull. Astron.*, April, 1885.)

THE MOON: *Lunar heat.*—At the Albany meeting of the National Academy of Sciences in October, 1885, Professor Langley read a paper "On the temperature of the surface of the moon."

Attempts were made in the last century by several physicists to obtain indications of heat from the moon, but without success. Professor Forbes, in 1885, employed a lens by which the lunar heat was concentrated about 6,000 times, but obtained no certain evidence of heat, being led only to the negative conclusion, that the warming effect of the full moon on the surface of the earth would, at any rate, not exceed $\frac{1}{300000}$ of a degree, Centigrade. The first satisfactory evidence of actual heat was obtained by Melloni in 1846, who, with a polyzonal burning lens, one meter in aperture, and by the aid of the newly invented thermopyle, in the clear air of Vesuvius, after due precaution against instrumental error, succeeded in obtaining decisive indications of heat, although the amount was all but immeasurably small. Later observers were also able to do little more than detect evidence of the existence of lunar heat, and the first attainments of anything like quantitative measurement thereof, was reserved for Lord Rosse, whose experiments are recorded in the proceedings of the Royal Society, commencing in 1869. The paper now before us details the experiments by Professor Langley, at the Allegheny Observatory, with the instrument invented about five years ago, and denominated the bolometer. The first of these were made on the evening of November 12, 1880, chiefly with the view of testing its sensitiveness, concentrating the lunar rays upon its face by means of the 13-inch equatorial of the observatory, and a smaller convex lens near its focus, when an average deflection of forty-two divisions of the galvanometer scale was obtained. In June, 1883, the bolometer and its adjuncts, having been much improved in the interval, measurements of the lunar heat were resumed with apparatus better adapted to the purpose. The heat radiated from the lunar surface may consist of three kinds in different proportions: (1) Heat coming from the interior of the moon, which will not vary with the phase; (2) heat which falls from the sun on the moon's surface, and is at once reflected regularly and irregularly; (3) heat which, falling from the sun on the moon's surface, is absorbed, raises the temperature of the surface, and is afterwards radiated as heat of low refrangibility. The general conclusion of Professor Langley's observations is thus expressed by himself. "While we have found abundant evidence of heat from the moon, every method we have tried, or that has been tried by others, for determining the character of this heat appears to us inconclusive; and without questioning that the moon radiates heat earthward from its soil, we have not yet found any experimental means of discriminating with such certainty between this and reflected heat that it is not open to misinterpretation. Whether we do so or not in the future will probably depend on our ability to measure by some process which will inform us directly of the wave-lengths of the heat observed." Combined with his experiments on solar radiation, Professor Langley's investigations seem to point to the probability of a gaseous envelope to the moon, too small to make its presence known in ordinary astronomical observations; and it is well known that Mr. Neison has advocated this view from other considerations in his great work on the moon. (*Athenæum.*)

Eclipse of the moon, 1884, *October* 4.—In spite of the very unfavorable atmospheric conditions in Central Europe, nearly forty observatories participated in the observation of this eclipse and were able to furnish valuable material, which will be made the subject of a special publication when the positions of all the occulted stars shall have been determined with the necessary precision. While awaiting the .termination of this great piece of work, Professor Struve gives a succinct résumé of the results due to the co-operation of so many workers in the *Astronomische Nachrichten*, Nos. 2640–46.

MARS: *The rotation period of Mars.*—The seventh volume of the *Annals* of the Leyden Observatory contains a very thorough and painstaking investigation by Professor Bakhuyzen of the rotation period of the planet Mars. In previous determinations one of two courses has usually been adopted, either to compare drawings of Huygens or Hooke with the most recent observations attainable, or to discuss some modern series which seemed to promise to compensate for its restricted range by its greater accuracy. Professor Bakhuyzen has, however, endeavored to utilize the entire mass of observations at his disposal, so as to avoid the sources of error to which the other methods are liable, and he possesses a great advantage over earlier investigators, in having access, not only to the numerous observations made in 1877 and 1879, but also to the great series of more than 200 drawings which Schroeter had prepared for his projected "Areographischen Beiträge," and which becoming the property of the University of Leyden in 1876, was edited and published by Professor Bakhuyzen in 1881. Professor Bakhuyzen, in the reduction of these drawings, has adopted provisionally Schiaparelli's position for the pole of Mars—R. A. 317° 46′·0, Decl. 53° 25′·4, mean equinox of 1833·0—and Proctor's rotation period—$24^h\ 37^m\ 22^s{\cdot}74$—and deduces corrections to these elements from a comparison of the results obtained by reducing the various observations at his command with them. His first step is, from a discussion of the drawings of Kaiser, Lockyer, Lord Rosse, and Dawes, made during the oppositions of of 1862 and 1864, to obtain the time of transit on January 1, 1863, of his adopted prime meridian over the Martial meridian, which passes through the earth's north pole, choosing as his prime meridian the one which lies 2° to the east of the center of Mädler's point *a*, corresponding almost exactly to Schiaparelli's *Fastigium Aryn*, or to Proctor's *Dawes Forked Bay*, he finds the time of transit over the meridian passing through the north pole of the earth on January 1, 1863, to be $20^h\ 27^m \pm 4{\cdot}0^m$, Berlin M. T. The areographic longitude of the center of the *Oculus*, the conspicuous circular spot, called by Green the *Terby Sea*, and by Schiaparelli *Lacus Solis*, will be, with this prime meridian, 90°·87. The second section contains the determination of areographic longitudes of ten of the most conspicuous and easily identified markings on the surface of Mars as inferred by means of the above elements from the drawings of various observers from the time of Hooke and Huygens up to 1879. For the last-named year only Schiaparelli's observations are used, but for 1877 there is an abundant supply, there being available, besides the observations of Schiaparelli, the drawings of Lohse, Green, Dreyer, and Niesten. Beer and Mädler's drawings afford material for 1830, Herschel and Schroeter give a very full series from 1777 to 1803, and Huygens and Hooke supply a few drawings from 1659 to 1683, from which the longitude of Mädler's *f*, the *Kaiser* or *Hourglass Sea*, Schiaparelli's *Syrtis Major*, can be inferred. These logitudes are discussed in the third section, and a corrected rotation period is obtained of $24^h\ 37^m\ 22^s{\cdot}66 \pm 0^s{\cdot}0132$, a value exceedingly close to the mean of the best previous determinations, which are as follows:

	h.	m.	s.
Kaiser, 1864	24	37	22·62
Kaiser, 1873			·591
Schmidt, 1873			·57
Proctor, 1868			·735

"Proctor's value is clearly too large, a comparison of the mean longitudes obtained for the *Kaiser Sea* with his period showing a steady decrease for successive oppositions; the only observations which stand conspicuously out from the rest being those of Hooke, upon which he had based his determination. There can be no doubt that Professor Bakhuyzen's value is a distinct improvement upon the earlier ones, and that its uncertainty lies only in the second place of the decimals. A table for computing the time of transit of the prime meridian over that meridian of Mars which passes through the earth's north pole, completes the memoir.

Professor Bakhuyzen supplies also a short note as to changes on the surface of Mars. The most conspicuous of all the markings on the planet's surface has always been the *Kaiser Sea;* but the drawings of Schroeter and Herschel, as Dr. Terby has already pointed out, exhibit a second marking near it, nearly as conspicuous, and very similar in shape and size. There can be no doubt that the only modern representative of this spot is *Huggins Inlet*, Schiaparelli's *Cyclopum*, a narrow streak, by no means easily observed, and now entirely unlike the *Kaiser Sea* in shape. Professor Bakhuyzen also considers that there is sufficient evidence for thinking that Schroeter on several occasions observed Schiaparelli's *Læstrygonum*—one of the most difficult objects on the planet—which could scarcely have been the case had it not been much more conspicuous than it has been of late years. These changes, Professor Bakhuyzen thinks, lend a high degree of probability to the theory that certain districts of Mars are covered by liquid." (*Nature*, November 12, 1885.)

JUPITER: Mr. W. F. Denning has given in *Nature* (32: 31–34, May 14, 1885) a summary of recent observations of the markings on Jupiter, with resulting rotation periods, &c. The great red spot has surprised us by its extended duration. As early as 1882 it lost such a considerable depth of tone that obliteration seemed imminent, but it has lingered on, until now its existence appears likely to be indefinitely prolonged, though under visible conditions far less imposing than at an earlier stage. All that at present remains of this remarkable formation is a dusky elliptic ring, darkest at the following end, and only well seen under good definition. Whether this ellipse is identical with similar appearances delineated by Dawes in 1857, Huggins in 1858, and Gledhill in 1869, 1870, and 1871, is involved in doubt, because of the lack of intermediate observations. We have no definite information as to what became of the various objects alluded to. It is very possible that they severally represent an object of considerable permanency. The changes such as observed may have been induced by atmospheric interference. There is every indication that the dense vaporous envelopes of this planet are rapidly variable, especially in the zone included by the two equatorial belts, and that the chief features undergo singular fluctuations, some of which may possibly be of periodical character. The red spot has now been followed since 1878. During the last three years it has given a rotation period of $9^{h}\,55^{m}\,39^{s}{\cdot}1$, which has been steadily maintained throughout each opposition, subject to some minor disturbances partly due to errors of observation. The first few years of its existence it showed an increasing retardation of motion, which lengthened the period from $9^{h}\,55^{m}\,34^{s}$ to that already quoted, but, contemporarily with the decay of the spot in 1882, the velocity ceased to slacken, and the results accumulated during the past few oppositions, prove it to have been equable in a marked degree.

With reference to the equatorial white spot some striking phenomena have been presented during the past winter. Between October 4, 1884, and January 13, 1885, its motion appears to have increased in an alarming ratio. The spot continued to rush on far in advance of its computed places, and all the while exhibited a more brilliant appearance than at any preceding epoch since the autumn of 1880, when it first came under systematic observation. The form and appearance of the spot have been so special as to prevent any confusion in mistaking it for other white spots in nearly the same latitude. Between October 4 and January 13, 1885, the rotation period was $9^{h}\,49^{m}\,51^{s}{\cdot}95$, but the great increase in velocity evidently occurred towards the end of November. Between November 21, 1884, and January 13, 1885, the period was only $9^{h}\,49^{m}\,38^{s}{\cdot}45$, or 34 seconds less than the mean period of $9^{h}\,50^{m}\,12^{s}{\cdot}25$ shown by the same spot during the two preceding years.

"Of the new features presented during the last few months the most striking are:" (1) The appearance of large, bright spots indenting the north edge of the great northern equatorial belt. (2) The outbreak of dark, reddish spots, elongated in longitude, upon the narrow belt which became visible in 1882, immediately outlying the great belt. One of the most conspicuous of these new spots is about 10,000 miles long. (3) The fading away of the west shoulder of the depression north of the red spot.

Professor Young remarked * a peculiar white cloud of oval form partially covering the "red spot," in March, 1885. This veil was almost concentric with the spot, leaving visible only a narrow ring of the red substance not more than $1\frac{1}{2}''$ to $2''$ in width. The outline of the cloud was for the most part sensibly smooth and regular, but at the preceding end there was a little projection nearly cutting across the red ring. The white cloud was not brilliant, but was very nearly of the same tint as the white belt on which the red spot lies.

At the Dearborn Observatory, Chicago, the systematic observation of the markings on Jupiter has been continued by Professor Hough: his results are given in full in his annual report for 1885, which contains sketches of the planet on November 7, 1884, and February 27, April 26, and May 15, 1885.

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* *Observatory,* VIII: 172.

SATURN: *The density of Saturn's ring.*—"M. Poincaré supplies a short note on the stability of Saturn's ring in the November number of the *Bulletin Astronomique.* Laplace had shown that the ring could only be stable if it were divided into several concentric rings revolving at different speeds. M. Tisserand had confirmed this result, and had recognized that a single ring must, in order to exist, possess a much higher density than the planet, and had calculated the maximum breadth of each elementary ring in terms of its density and mean radius. M. Poincaré has carried this investigation a step further, and shown that if the density of a ring be less than a certain amount, it will, under the influence of the slightest perturbation, no longer break up into a number of narrower rings, but into a great number of satellites, and that if the rings be fluid and turn each as a single piece, the density of the inner ring must be at least $\frac{1}{5}$, and of the outer ring $\frac{1}{16}$ that of the planet. For a ring of very small satellites (not for a fluid ring, as M. Poincaré erroneously states), Maxwell has shown the condition to be that the density should not *exceed* $\frac{1}{300}$ part of that of Saturn.

"We do not at present know the actual density of the ring from observation sufficiently accurately to make therefrom any certain inference as to its physical condition. Bessel's determination from the movement of the peri-saturnium of the orbit of Titan gave the reciprocal of the mass of the ring as compared with that of Saturn as 118, which since the volume of the ring—adopting Bond's value of 40 miles for its thickness—is about $\frac{1}{400}$ that of the planet, would make its density about 3·4 times greater than the planet's. Bessel's value is, however, clearly too great, as he neglected the influence of the equatorial protuberance of Saturn on the movement of the apsides. Meyer's determination of the secular variation of the line of apsides of Titan, viz $d\pi = 1726''.5$, gives the reciprocal of the mass of the ring as 26,700, but from all the six brighter satellites as 1,960; the latter value closely agreeing with Tisserand's. It does not, however, seem to have been noticed that even the smallest value for the mass considerably exceeds the highest permissible in accordance with Maxwell's result, since that would make the mass of the rings only $\frac{1}{120000}$ part of the planet's, an amount we cannot hope to detect with our present resources." (*Nature*, January 28, 1886, vol. 33: p. 303.)

Sur la Variabilité des Anneaux de Saturne.—"Observers have as yet discovered no fact that could lead them to suppose the rings of Saturn to have as a whole a rotary motion about the planet. Now if such a motion exists, it is inconceivable that it should have thus far escaped observation. But if these rings do not revolve about the planet, we cannot admit that they are solid, liquid, or even gaseous, for it is evident that such frail structures could not resist the force exercised upon them by the constantly variable attraction in the direction of the satellites. If it is true that without rotation the rings could be neither solid, liquid, nor gaseous, we must seek some explanation that shall satisfy the necessary conditions. The rings must move about the planet without there being revolution properly so called of the rings; they must be solid without being rigid. There seems to be no way of satisfying these conditions and at the same time easily explaining all the observed phenomena other than the hypothesis conceived by Cassini II and recently developed by Proctor and Clerk-Maxwell, which supposes the rings to be formed of disconnected material of thousands of little independent bodies, asteroids, circling around the planet in independent and concentric orbits not exactly in the same plane, and completing their revolutions in different times. It is evident that all the combinations necessary for explaining the observed phenomena would be possible in such a system; these bodies would explain certain phenomena in proportion as they are more or less numerous, more or less separated by space, more or less rare, &c. If we suppose (what is a very probable thing) that these bodies possess different reflective powers, we can conceive of all sorts of combinations of light, from the brilliant rings to the dark-gray bands, In short this hypothesis appears to be entirely sufficient to explain the rings of Saturn and their variability." (Trouvelot in *Bull. Astron.*, January, 1885.)

The orbit of Tethys.—"Herr Karl Bohlin has recently communicated to the Swedish Academy of Sciences an interesting discussion of the elements of the orbit of Tethys. The observations discussed are those of Sir William Herschel, 1789, reduced by Lamont; Lamont, 1836; Sir J. Herschel, 1835–'37; the Bonds, 1848–'52; Secchi, 1856; Captain Jacob, 1857–'58; Newcomb and Holden, 1874–'75, and Meyer, 1880–'81. The elements are calculated for each period of observation, without taking account of perturbations. Herr Bohlin, then specially treating the mean longitude of the epoch, and adopting 190°·69812 as the value of the mean motion, draws up tables of the differences between observation and calculation, and attemps to represent them by an empirical formula. The corrected value of the mean motion is 190°.698169, almost identical with that found previously by M. Baillaud. Herr Bohlin finds that the annual motion of the peri-saturnium amounts to 33°. M. Baillaud's results and M. Tisserand's investigations had given the value as 70°. The eccentricity is found as 0·00803 ± 0·00077." (*Nature*, January 28, 1886.)

The orbit of Iapetus.—An elaborate paper on the orbit of Iapetus, the outermost satellite of Saturn, by Prof. Asaph Hall, forms Appendix I, a quarto pamphlet of 82 pages, recently published, to the Washington Observations for 1882. Iapetus was discovered on the 25th of October, 1671, by Cassini with a telescope of 17 feet focal length. Titan, the brightest of the satellites of Saturn, was discovered by Huyghens on the 25th of March, 1655, and Huyghens was deterred, apparently, from further search by his belief that the solar system was now complete, this discovery making the number of satellites equal to the number of planets and making six* of each, which was universally admitted to be a "perfect" number. Curious variations in the brightness of the new satellite were noticed by Cassini, and his observations have been confirmed by subsequent observers. The explanation seems to be that opposite sides of the satellite have different reflecting powers, and that the satellite, in revolving around Saturn, keeps the same face always turned towards the planet. In this latter respect we have an analogous case in our moon. Professor Pickering gives the magnitude of Iapetus, from photometric measures, 11·82, and the mean diameter 486 miles.

The observations now published were, for the most part, made by Professor Hall himself with the 26-inch equatorial of the Naval Observatory, in the years 1875–'84; a few were made by Professor Newcomb in 1874. In regard to the examination of the observations for large residuals, Professor Hall remarks: " In this work no observation has been rejected. When observations have been honestly made, I dislike to enter on the process of culling them. By rejecting the large residuals the work is made to appear more accurate than it really is, and thus we fail to get the right estimate of its quality."

The adopted mean distance of Iapetus from Saturn, determined by two different methods of observing, (one by differences of right ascension and declination and the other by angles of position and distances,) which give very accordant results, is $515\cdot''5195 \pm 0\cdot''02645$; and the time for one revolution around the planet seventy-nine days, seven hours, fifty-six minutes, forty seconds. From this periodic time of the satellite and its mean distance, the mass of Saturn expressed as a fraction of the sun's mass is $\frac{1}{3481}$, or about 93·2 times the mass of the earth. Professor Hall's paper concludes with some useful tables of the satellite's motion.

URANUS: *The satellites of Uranus.*—In Appendix I to the Washington Observations for 1881 Prof. Asaph Hall has published the results of his investigations of the orbits of Uranus, "*Oberon*" and "*Titania.*" "The satellites of Uranus were amongst the first objects observed with the 26-inch refractor of the Naval Observatory, after it was mounted in November, 1873. The first series during the oppositions of 1874 and 1875 were discussed by Professor Newcomb, with the view to the determination of the mass of the planet, and the formation of tables of the motions of the satellites, which were published in the Washington Observations for 1873. Remarking that as the earth would be nearly in the plane of the orbits in the year 1882, and observations made about that year would probably afford a good determination of the position of this plane, Professor Hall commenced a new series in March, 1881, which was continued through the four oppositions to the end of May, 1884; these observations were made with magnifiers of 606 and 888; in fair conditions of the atmosphere the outer satellites are stated to be easily observable with the Washington instrument. A comparison of the measures with Professor Newcomb's tables showed that these tables required but small corrections, which were found by equations of conditions in the usual manner. It should be mentioned that the tables were founded mainly upon Professor Newcomb's own measures; these by Professor Hall in the year 1875 and 1876 are included in his recent discussion.

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* Professor Hall has called my attention to a slight error in Grant's rendering of Huyghens' remark (History of Physical Astronomy, p. 268). The discovery of Titan made the number of planets and satellites, each equal to six, and *six* (not twelve, as Grant puts it) was regarded as a "perfect" number: " - - - utrique illo, quem perfectum dicimus, numero continentur - - - " Huygenii Opera Varia, vol. 2, p. 530), a perfect number being one that is equal to the sum of all its divisors including unity.

"For the position of the nodes and inclination of the orbits of the satellites, Professor Hall finds—

$$N=165^\circ{\cdot}81+0^\circ{\cdot}0142t$$
$$I=\ 75^\circ{\cdot}30-0^\circ{\cdot}0014t$$

t being the number of years from 1883.0.

"The mean value of the mass of Uranus by the observations of Oberon is $\frac{1}{22603}$, and by those of Titania $\frac{1}{22833}$, or, combining the values with their respective weights, the final result is $\frac{1}{22682}$. This value, though somewhat smaller than those previously obtained, Professor Hall thinks, is as good as he could obtain with the filar micrometer of the large refractor, and he does not consider that there would be much gained by a continuation of the measures. He mentions that during the oppositions of the planet from 1881 to 1884, which were especially favorable for the search after new satellites, he made careful examination on several good nights along the orbit plane of the known satellites without finding any new ones. The orbits of Oberon and Titania appear to be sensibly circular." (*Nature.*)

NEPTUNE: *The satellite of Neptune.*—Appendix II to the Washington Observations for 1881 contains Professor Hall's discussion of the observations of this satellite, which were made by Professor Holden and himself with the 26-inch Washington refractor: the discussion includes also observations made by Lassell and Marth at Malta in 1863 and 1864. Corrections (which come out quite small) are given for Newcomb's elements of the orbit, published in Appendix I to Washington Observations for 1873. Comparing the observations of 1881 to 1884 with those of Lassell and Marth, the periodic time is found to be 5·876839 mean solar days. Lassell's period of the satellite, which has been adopted by Newcomb, appears to be slightly erroneous. The question of the eccentricity of the orbit may be more advantageously attacked some ten or twenty years hence, when the apparent ellipse has become more nearly circular, and when there will be a better opportunity to determine this element.

The values of the mass of Neptune from Hall's measures at different oppositions, and from those of Lassell and Marth and of Holden, differ sensibly. The mean result from Hall's own observations is $\frac{1}{19092}$; he remarks that his distances are generally smaller than those of other observers, and believes that in order to eliminate the effect of such personal equation from the determination of the mass of a planet, the only way will be to increase the number of observers and to take a mean of the results. On favorable nights examinations of the region about Neptune were made, but no other satellite was detected.

Photometric observations of Neptune.—A series of observations of the planet's magnitude was carried on with the meridian photometer at Harvard College Observatory from December 16, 1884, to January 21, 1885; the resulting magnitude for mean opposition is 7·63. Professor Pickering regards it as improbable that there is any variation in the light of Neptune of a strictly periodic character.

THE TRANS-NEPTUNIAN PLANET.—In the twentieth volume of the *American Journal of Science*, page 225 *et seq.*, Prof. D. P. Todd, now of Amherst College, gave an account of his search, theoretical and practical, for the trans-Neptunian planet, made from November, 1877, to March, 1878, with the 26-inch refractor of the Washington Observatory. Professor Todd has now published* the full details of his telescopic work, giving a list of all "suspected objects," and transcribing his notebook entire.

It was expected that the planet would readily be recognized by the contrast of its disc and light with the appearance of an average star of about the thirteenth magnitude, and only approximate positions of "suspected objects" are given,—generally by means of diagrams representing the configuration of stars seen in the large telescope and in the field of the 5-inch finder. It would lighten considerably the labors of any one who may go over this ground in the future, if Professor Todd had summarized his observations in some way, by establishing the identity or non-identity of nebulous objects which he has noted, as probably to be found in Herschel's General Catalogue, and by giving a list of such objects as he was still, at the end of his work, inclined to look upon with some suspicion.

Although this search was unsuccessful, Professor Todd regards the evidence of the existence of "*the* trans-Neptune planet" as well founded, and he expresses the hope that the search may be continued with the improved methods of astronomical photography.

THE MINOR PLANETS.—During the year 1885 the number of minor planets has been increased by nine, bringing the whole number now known up to 253. The discoveries of 1885 were as follows:

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* *Proc. Am. Acad.*, 1885, 21: p. 228–43. *Astron. Nachr.*, 113: 153–66.

No.	Name.	Date of discovery.	Discoverer.	Observatory.
245	Vera	February 6	Pogson	Madras.
246	Asporina	March 6	Borrelly	Marseilles.
247	Eukrate	March 14	R. Luther	Düsseldorf.
248	Lameia	June 5	J. Palisa	Vienna.
249	Ilse	August 16	Peters	Clinton.
250	Bettina	September 3	J. Palisa	Vienna.
251	Sophia	October 4	Do	Do.
252	Clementina	October 11	Perrotin	Nice.
253	———	November 12	J. Palisa	Vienna.

The increasing difficulties in this branch of astronomical discovery are forcibly suggested by the fact that four of these bodies were first taken for planets already known and their non-identity was only established by later observations.

Number 253 was discovered while searching for Erigone, and raises the whole number of those found by Palisa to fifty. Ilse is the forty-third discovered by Professor Peters.

Of the minor planets discovered in 1884, number 237 has received the name of Cœlestina (erroneously given as Hypatia in last year's report), Number 238 that of Hypatia, 239 Adrastea, 243 Ida, and 244 Sita. Up to February, 1885, there were still 18 which had been observed at only one opposition, excepting, of course, those discovered during the year preceding.

Ephemerides of the small planets for 1886 will be found in the *Berliner Astronomisches Jahrbuch* for 1888. There are approximate places for every twentieth day, of 247 out of the 253 now known, with accurately calculated opposition ephemerides for 19 of these. The elements of these first 247 are also given.

MM. Callandreau and Fabry give in the *Bulletin Astronomique* a set of tables which will be found very useful in computing approximate ephemerides for these small bodies, when the eccentricity of the orbit does not exceed 0·407 (=sin 24°).

A series of photometric observations of Ceres and Pallas made in April and May, 1885, at Harvard College Observatory gave Ceres =7·71 magnitude with a probable error from nine observations of 0·05; Pallas =8·55 magnitude with a probable error of 0·02 from ten observations. Twenty-two observations of Vesta were made in 1880–'82, giving the result 6·47 as the magnitude of the plant for mean opposition, and the probable error 0·04. Corresponding magnitudes for a distance of unity from the sun and from the observer for these three bodies would be 4·27, 5·10, and 3·93, respectively.

Mr. A. N. Skinner, of the United States Naval Observatory, has kindly furnished the following complete list of the minor planets. The first list gives the number, name, date of discovery, and the name of the discoverer: the subscript figure to the name of the discoverer is the discoverer's number. The second list is an alphabetical index of the first 252 minor planets.

The minor planets in the order of discovery.

No.	Name.	Date.	Discoverer.
		1801.	
1	Ceres	Jan. 1	Piazzi.
		1802.	
2	Pallas	Mar. 28	Olbers$_{1}$.
		1804.	
3	Juno	Sept. 1	Harding.
		1807.	
4	Vesta	Mar. 29	Olbers$_{2}$.
		1845.	
5	Astræa	Dec. 8	Hencke$_{1}$.
		1847.	
6	Hebe	July 1	Hencke$_{2}$.
7	Iris	Aug. 13	Hind$_{1}$.
8	Flora	Oct. 18	Hind$_{2}$.
		1848.	
9	Metis	Apr. 25	Graham.
		1849.	
10	Hygeia	Apr. 12	De Gasparis$_{1}$.
		1850.	
11	Parthenope	May 11	De Gasparis$_{2}$.
12	Victoria	Sept. 13	Hind$_{3}$.
13	Egeria	Nov. 2	De Gasparis$_{3}$.
		1851.	
14	Irene	May 19	Hind$_{4}$.
15	Eunomia	July 29	De Gasparis$_{4}$.
		1852.	
16	Psyche	Mar. 17	De Gasparis$_{5}$.
17	Thetis	Apr. 17	Luther$_{1}$.
18	Melpomene	June 24	Hind$_{5}$.
19	Fortuna	Aug. 22	Hind$_{6}$.
20	Massalia	Sept. 19	De Gasparis$_{6}$.
21	Lutetia	Nov. 15	Goldschmidt$_{1}$.
22	Calliope	Nov. 16	Hind$_{7}$.
23	Thalia	Dec. 15	Hind$_{8}$.
		1853.	
24	Themis	Apr. 5	De Gasparis$_{7}$.
25	Phocæa	Apr. 6	Chacornac$_{1}$.
26	Proserpina	May 5	Luther$_{2}$.
27	Euterpe	Nov. 8	Hind$_{9}$.
		1854.	
28	Bellona	Mar. 1	Luther$_{3}$.
29	Amphitrite	Mar. 1	Marth.
30	Urania	July 22	Hind$_{10}$.
31	Euphrosyne	Sept. 1	Ferguson$_{1}$.
32	Pomona	Oct. 26	Goldschmidt$_{2}$.
33	Polyhymnia	Oct. 28	Chacornac$_{2}$.
		1855.	
34	Circe	Apr. 6	Chacornac$_{3}$.
35	Leucothea	Apr. 19	Luther$_{4}$.
36	Atalante	Oct. 5	Goldschmidt$_{3}$.
37	Fides	Oct. 5	Luther$_{5}$.
		1856.	
38	Leda	Jan. 12	Chacornac$_{4}$.
39	Lætitia	Feb. 8	Chacornac$_{5}$.
40	Harmonia	Mar. 31	Goldschmidt$_{4}$.
41	Daphne	May 22	Goldschmidt$_{5}$.
42	Isis	May 23	Pogson$_{1}$.
		1857.	
43	Ariadne	Apr. 15	Pogson$_{2}$.
44	Nysa	May 27	Goldschmidt$_{6}$.
45	Eugenia	June 27	Goldschmidt$_{7}$.
46	Hestia	Aug. 16	Pogson$_{3}$.
47	Aglaja	Sept. 15	Luther$_{6}$.
48	Doris	Sept. 19	Goldschmidt$_{8}$.
49	Pales	Sept. 19	Goldschmidt$_{9}$.
50	Virginia	Oct. 4	Ferguson$_{2}$.
		1858.	
51	Nemausa	Jan. 22	Laurent.
52	Europa	Feb. 4	Goldschmidt$_{10}$.
53	Calypso	Apr. 4	Luther$_{7}$.
54	Alexandra	Sept. 10	Goldschmidt$_{11}$
55	Pandora	Sept. 10	Searle.
		1857.	
56	Melete	Sept. 9	Goldschmidt$_{12}$
		1859.	
57	Mnemosyne	Sept. 22	Luther$_{8}$.
		1860.	
58	Concordia	Mar. 24	Luther$_{9}$.
59	Elpis	Sept. 12	Chacornac$_{6}$.
60	Echo	Sept. 14	Ferguson$_{3}$.
61	Danaë	Sept. 9	Goldschmidt$_{13}$.
62	Erato	Sept. 14	Foerster.
		1861.	
63	Ausonia	Feb. 10	De Gasparis$_{8}$.
64	Angelina	Mar. 4	Tempel$_{1}$.
65	Cybele	Mar. 8	Tempel$_{2}$.
66	Maja	Apr. 9	Tuttle$_{1}$.
67	Asia	Apr. 17	Pogson$_{4}$.
68	Leto	Apr. 29	Luther$_{10}$.
69	Hesperia	Apr. 29	Schiaparelli.
70	Panopæa	May 5	Goldschmidt$_{14}$.
71	Niobe	Aug. 13	Luther$_{11}$.
72	Feronia	May 29	C. H. F. Peters$_{1}$.
		1862.	
73	Clytia	Apr. 7	Tuttle$_{2}$.
74	Galatea	Aug. 29	Tempel$_{3}$.
75	Eurydice	Sept. 22	Peters$_{2}$.
76	Freia	Oct. 21	D'Arrest.
77	Frigga	Nov. 12	Peters$_{3}$.
		1863.	
78	Diana	Mar. 15	Luther$_{12}$.
79	Eurynome	Sept. 14	Watson$_{1}$.
		1864.	
80	Sappho	May 2	Pogson$_{5}$.
81	Terpsichore	Sept. 30	Tempel$_{4}$.
82	Alcmene	Nov. 27	Luther$_{13}$.
		1865.	
83	Beatrix	Apr. 26	De Gasparis$_{9}$.
84	Clio	Aug. 25	Luther$_{14}$.
85	Io	Sept. 19	Peters$_{4}$.
		1866.	
86	Semele	Jan. 4	Tietjen.
87	Sylvia	May 16	Pogson$_{6}$.
88	Thisbe	June 15	Peters$_{5}$.
89	Julia	Aug. 6	Stephan.
90	Antiope	Oct. 1	Luther$_{15}$.
91	Ægina	Nov. 4	Borrelly$_{1}$.
		1867.	
92	Undina	July 7	Peters$_{6}$.
93	Minerva	Aug. 24	Watson$_{2}$.
94	Aurora	Sept. 6	Watson$_{3}$.
95	Arethusa	Nov. 23	Luther$_{16}$.
		1868.	
96	Ægle	Feb. 17	Coggia$_{1}$.
97	Clotho	Feb. 17	Tempel$_{5}$.
98	Ianthe	Apr. 18	Peters$_{7}$.
99	Dike	May 28	Borrelly$_{2}$.
100	Hecate	July 11	Watson$_{4}$.
101	Helena	Aug. 15	Watson$_{5}$.
102	Miriam	Aug. 22	Peters$_{8}$.
103	Hera	Sept. 7	Watson$_{6}$.
104	Clymene	Sept. 13	Watson$_{7}$.
105	Artemis	Sept. 16	Watson$_{8}$.
106	Dione	Oct. 10	Watson$_{9}$.
107	Camilla	Nov. 17	Pogson$_{7}$.
		1869.	
108	Hecuba	Apr. 2	Luther$_{17}$.
109	Felicitas	Oct. 9	Peters$_{9}$.
		1870.	
110	Lydia	Apr. 19	Borrelly$_{3}$.
111	Ate	Aug. 14	Peters$_{10}$.
112	Iphigenia	Sept. 19	Peters$_{11}$.
		1871.	
113	Amalthea	Mar. 12	Luther$_{18}$.
114	Cassandra	July 23	Peters$_{12}$.
115	Thyra	Aug. 6	Watson$_{10}$.
116	Sirona	Sept. 8	Peters$_{13}$.
117	Lomia	Sept. 12	Borrelly$_{4}$.
		1872.	
118	Peitho	Mar. 15	Luther$_{19}$.
119	Althæa	Apr. 3	Watson$_{11}$.
120	Lachesis	Apr. 10	Borrelly$_{5}$.
121	Hermione	May 12	Watson$_{12}$.
122	Gerda	July 31	Peters$_{14}$.
123	Brunhild	July 31	Peters$_{15}$.
124	Alceste	Aug. 23	Peters$_{16}$.
125	Liberatrix	Sept. 11	Prosper Henry$_{1}$.
126	Velleda	Nov. 5	Paul Henry$_{1}$.
127	Johanna	Nov. 5	Prosper Henry$_{2}$.
128	Nemesis	Nov. 25	Watson$_{13}$.
		1873.	
129	Antigone	Feb. 5	Peters$_{17}$.
130	Electra	Feb. 17	Peters$_{18}$.
131	Vala	May 24	Peters$_{19}$.

The minor planets in the order of discovery—Continued.

No.	Name.	Date.	Discoverer.
		1873.	
132	Æthra	June 13	Watson 14.
133	Cyrene	Aug. 16	Watson 15.
134	Sophrosyne	Sept. 27	Luther 20.
		1874.	
135	Hertha	Feb. 18	Peters 20.
136	Austria	Mar. 18	Palisa 1.
137	Melibœa	Apr. 21	Palisa 2.
138	Tolosa	May 19	Perrotin 1.
139	Juewa	Oct. 10	Watson 16.
140	Siwa	Oct. 13	Palisa 3.
		1875.	
141	Lumen	Jan. 13	Paul Henry 2.
142	Polana	Jan. 28	Palisa 4.
143	Adria	Feb. 23	Palisa 5.
144	Vibilia	June 3	Peters 21.
145	Adeona	June 3	Peters 22.
146	Lucina	June 8	Borrelly 6.
147	Protogeneia	July 10	Schulhof.
148	Gallia	Aug. 7	Prosper Henry 3.
149	Medusa	Sept. 21	Perrotin 2.
150	Nuwa	Oct. 18	Watson 17.
151	Abundantia	Nov. 1	Palisa 6.
152	Atala	Nov. 2	Paul Henry 3.
153	Hilda	Nov. 2	Palisa 7.
154	Bertha	Nov. 4	Prosper Henry 4.
155	Scylla	Nov. 8	Palisa 8.
156	Xanthippe	Nov. 22	Palisa 9.
157	Dejanira	Dec. 1	Borrelly 7.
		1876.	
158	Coronis	Jan. 4	Knorre 1.
159	Æmilia	Jan. 26	Paul Henry 4.
160	Una	Feb. 20	Peters 23.
161	Athor	Apr. 19	Watson 18.
162	Laurentia	Apr. 21	Prosper Henry 5.
163	Erigone	Apr. 26	Perrotin 3.
164	Eva	July 12	Paul Henry 5.
165	Loreley	Aug. 9	Peters 24.
166	Rhodope	Aug. 15	Peters 25.
167	Urda	Aug. 28	Peters 26.
168	Sibylla	Sept. 28	Watson 19.
169	Zelia	Sept. 28	Prosper Henry 6.
		1877.	
170	Maria	Jan. 10	Perrotin 4.
171	Ophelia	Jan. 13	Borrelly 8.
172	Baucis	Feb. 5	Borrelly 9.
173	Ino	Aug. 1	Borrelly 10.
174	Phædra	Sept. 2	Watson 20.
175	Andromache	Oct. 1	Watson 21.
176	Idunna	Oct. 14	Peters 27.
177	Irma	Nov. 5	Paul Henry 6.
178	Belisana	Nov. 6	Palisa 10.
179	Clytemnestra	Nov. 11	Watson 22.
		1878.	
180	Garumna	Jan. 29	Perrotin 5.
181	Eucharis	Feb. 2	Cottenot.
182	Elsa	Feb. 7	Palisa 11.
183	Istria	Feb. 8	Palisa 12.
184	Dejopeja	Feb. 28	Palisa 13.
185	Eunike	Mar. 1	Peters 28.
186	Celuta	Apr. 6	Prosper Henry 7.
187	Lamberta	Apr. 11	Coggia 2.
188	Menippe	June 18	Peters 29.
189	Phthia	Sept. 9	Peters 30.
190	Ismene	Sept. 22	Peters 31.
191	Kolga	Sept. 30	Peters 32.
		1879.	
192	Nausicaä	Feb. 17	Palisa 14.
		1879.	
193	Ambrosia	Feb. 28	Coggia 3.
194	Prokne	Mar. 21	Peters 33.
195	Eurykleia	Apr. 19	Palisa 15.
196	Philomela	May 14	Peters 34.
197	Arete	May 21	Palisa 16.
198	Ampella	June 13	Borrelly 12.
199	Byblis	July 9	Peters 35.
200	Dynamene	July 27	Peters 36.
201	Penelope	Aug. 7	Palisa 17.
202	Chryseïs	Sept. 11	Peters 37.
203	Pompeia	Sept. 25	Peters 38.
204	Callisto	Oct. 8	Palisa 18.
205	Martha	Oct. 13	Palisa 19.
206	Hersilia	Oct. 13	Peters 39.
207	Hedda	Oct. 17	Palisa 20.
208	Lacrimosa	Oct. 21	Palisa 21.
209	Dido	Oct. 22	Peters 40.
210	Isabella	Nov. 12	Palisa 22.
211	Isolda	Dec. 10	Palisa 23.
		1880.	
212	Medea	Feb. 6	Palisa 24.
213	Lilæa	Feb. 16	Peters 41.
214	Aschera	Feb. 29	Palisa 25.
215	Oenone	Apr. 7	Knorre 2.
216	Cleopatra	Apr. 10	Palisa 26.
217	Eudora	Aug. 30	Coggia 4.
218	Bianca	Sept. 4	Palisa 27.
219	Thusnelda	Sept. 30	Palisa 28.
		1881.	
220	Stephania	Feb. 23	Palisa 29.
		1882.	
221	Eos	Jan. 18	Palisa 30.
222	Lucia	Feb. 9	Palisa 31.
223	Rosa	Mar. 9	Palisa 32.
224	Oceana	Mar. 30	Palisa 33.
225	Henrietta	Apr. 19	Palisa 34.
226	Weringia	July 19	Palisa 35.
227	Philosophia	Aug. 12	Paul Henry 7.
228	Agathe	Aug. 19	Palisa 36.
229	Adelinda	Aug. 22	Palisa 37.
230	Athamantis	Sept. 3	De Ball. 1
231	Vindobona	Sept. 10	Palisa 38.
		1883.	
232	Russia	Jan. 31	Palisa 39.
233	Asterope	May 11	Borrelly 12.
234	Barbara	Aug. 12	Peters 42.
235	Carolina	Nov. 28	Palisa 40.
		1884.	
236	Honoria	Apr. 26	Palisa 41.
237	Cœlestina	June 27	Palisa 42.
238	Hypatia	July 1	Knorre 3.
239	Adrastea	Aug. 18	Palisa 43.
240	Vanadis	Aug. 27	Borrelly 13.
241	Germania	Sept. 12	Luther 21.
242	Kriemhild	Sept. 22	Palisa 44.
243	Ida	Sept. 29	Palisa 45.
244	Sita	Oct. 14	Palisa 46.
		1885.	
245	Vera	Feb. 6	Pogson 8.
246	Asporina	Mar. 6	Borrelly 14.
247	Eukrate	Mar. 14	Luther 22.
248	Lameia	June 5	Palisa 47.
249	Ilse	Aug. 16	Peters 43.
250	Bettina	Sept. 3	Palisa 48.
251	Sophia	Oct. 4	Palisa 49.
252	Clementina	Oct. 11	Perrotin 6.
253	————	Nov. 12	Palisa 50.

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REPORTS OF OBSERVATORIES.

The following account of the recent activity of astronomical observatories has been derived from the "Jahresberichte der Sternwarte für 1884," in the *Vierteljahrsschrift der Astronomischen Gesellschaft*, volume 20 (a condensed translation of this appeared in the *Sidereal Messenger*, September, 1885), and from the reports of observatories for 1885 that have been published up to the present date (April, 1885): the reports of English observatories are largely obtained from the *Monthly Notices*. *Sirius* XIX: 14–18, 64–66) contains brief descriptions, &c., of Austro-Hungarian observatories.

Armagh.—The building for the new 10-inch Grubb equatorial (10 feet focal length) was erected in July last. The dome moves on 6 "canted" wheels and is covered with papier-mâché riveted to the iron framework and stitched together with copper wire. The declination circle can be read from the eye end, and both it and the right ascension circle can be illuminated by small incandescent lamps worked by a two-cell bichromate battery.

Bamberg Observatory.—Dr. Hartwig, recently of the Strassburg and Dorpat observatories, has been appointed director (January, 1886), and is busy with the preliminary arrangements for erecting the buildings.

Berlin (1884).—The large meridian circle has been dismounted and has received important mechanical improvements. The observations on the southern half of the Berlin Zone were temporarily stopped during the year. Dr. Kuestner has begun a series of observations with the object of determining the constant of aberration by measures of the difference of zenith distances of pairs of stars in the same R. A. and equal and opposite Z. D. The work is to be finished in 1885. Dr. Knorre has made a large number of observations with the 9·6-inch equatorial for the positions of asteroids, comets, and faint stars. The planet *Hypatia* was found by him July 1, 1884. Dr. Battermann is regularly observing occultations, both immersions and emersions. Dr. Marcuse has charge of the heliometer, and has made thirty-three determinations of the solar diameter, &c. Vol. v of the Berlin observations has been published during the year.

German Transit of Venus Commission (1884). The report of Dr. Auwers on the work of the computing bureau relates first to the *observations*. These are of three kinds: (1) Observations before the expeditions, for practice, and for the investigation of special points; (2) observations at the stations; and (3) observations made after the return of the parties. A list of the heliometer measures of each observer comprised in these classes is given separately, and a summary, from which it appears that the total number of complete measures with the four heliometers was:

Before and after the expeditions	1,769
At the stations themselves	1,074
In all, for thirteen observers	2,843

Bermerside, Halifax (Mr. Edward Crossley's observatory). Phenomena of the satellites of Jupiter and Saturn observed.

Bonn.—2881 zone stars (four hundred fundamental stars) were determined in the A. G. zone. The southern *Durchmusterung* has required the examination of some seven hundred and fifty places in the sky to solve doubts. In December, 1883, the charting of the stars on the maps was again begun and finally completed in March, 1885. The catalogue will contain 133,658 stars between — 2° and — 23°; 692 more are given north of these limits and 479 south.

Bordeaux.—This observatory, founded in 1871, has just now (*Comptes Rendus*, 101 : 690, 1885), published its first volume of *Annales*, containing a minute description of the instruments (a meridian circle of 0·19^{m} aperture, two equatorials of 0·22 and 0·39^{m}, and three clocks), and, also, a determination of the longitude of the observatory. An important piece of work has been undertaken by the director, M. Rayet, in the re-observation of the 23,000 stars in Argelander's southern zones, between — 15° and — 31° of declination. The latitude is given as +44° 50′ 7″·23. (*Science.*)

Boswell Observatory, of Doane College, Crete, Nebr., is due to the liberality of the late Charles Boswell, of West Hartford, Conn. The observatory possesses a full set of meteorological instruments in addition to its astronomical equipment, and is a signal-service station, cooperating with the United States Signal Service at Washington. A time-ball is dropped daily at noon.

Brussels.—The transit and mural are used to observe moon culminating stars. A general catalogue of the stars observed at Brussels in the years 1857–'78, reduced to 1865, will be printed during 1885. M. F. Folie, administrating inspector of the University of Liège, has been appointed director. Since the resignation of M. Houzeau, the direction has been in the hands of a committee of three, MM. Stas, Liagre, and Mailly.

Buchtel College Observatory, Akron, Ohio.—Approximate latitude, +41° 3′; approximate longitude, 5^{h} 26^{m} west of Greenwich. The observatory was erected in the summer of 1885, and the instruments set up about March 1, 1886. The following instruments are in use:

Transit circle of 3 inches aperture, by Fauth & Co., of Washington. The circles are 16 inches in diameter, one being coarsely divided on the edge and serving as a finder, the other being divided on silver to five-minute spaces and reading by two micrometer-microscopes to single seconds. The telescope is provided with right ascension and declination micrometers. A fine level is attached, so that the instrument can be used as a zenith telescope; reversing apparatus, plain and diagonal eye-pieces accompany the instrument.

Sidereal clock, by E. Howard & Co., of Boston. This clock is provided with electrical attachments for operating the chronograph. Chronograph, by Fauth & Co. Mean time clock, by Fauth & Co. This clock is provided with Gardner's electrical attachments for operating chronograph, dropping timeball, and correcting a system of controlled clocks.

Equatorial telescope of 4½ inches aperture, by Pike & Sons.

Sextant, by Fauth & Co.

The observatory was built as a working observatory for the college students in astronomy, and it will be chiefly devoted to this purpose. Besides this, the work for the following year will be, (1) to furnish the city and surrounding towns with correct time signals; (2) to determine the latitude and longitude; (3) to observe all occultations of stars that are visible here.

Cambridge (*England*) *Observatory.*—The total number of observations made with the transit circle during the year was 3,253, including 2,442 observations of zone stars made on one hundred nights. The observations of clock stars and those of Polaris are completely reduced, and the mean places for January 1 obtained up to the end of 1884. The true apparent places of all other stars observed in 1884 are also obtained, both in R. A. and N. P. D.

Christiania.—An equatorial of 360^{mm} aperture and 6·8^{m} focal length has been erected by Herr H. G. Olsen. (*Sirius.*)

Cincinnati Observatory.—No. 8 of the publications of this observatory, containing the observations of comets in 1883, has appeared during the past year (1885). "It is noteworthy as presenting a pretty complete report on the phenomena of Pons' periodical comet of 1812 at its reappearance. The features of the tail were particularly studied, and the discussion of the observations, based upon the theory of Dr. Bredichin, has been found to add confirmation to that theory." These observations were made by Mr. H. C. Wilson while in temporary charge. The observatory is now under the direction of Prof. J. G. Porter.

Constantinople.—It is reported that the Sultan has ordered the erection of an astronomical and meteorological observatory at Constantinople.

Cordoba Observatory.—Dr. B. A. Gould returned to the United States in April, 1885. He has been succeeded as director of the Cordoba Observatory by his first assistant, Dr. John M. Thome. Dr. Gould has published as the final definitive position of the Cordoba meridian circle: Latitude, $-31° 25' 15''·46$; longitude, $4^{h} 16^{m} 48^{s}·2$ west of Greenwich.

Dearborn Observatory.—Professor Hough's report for the year ending May 20, 1885, states that the meridian circle has been used for determination of time, which is furnished daily to the city of Chicago. A full description is given of a printing chronograph. The work with the great equatorial has been confined mainly to difficult double stars and the planet Jupiter. Four sketches of Jupiter accompany the report. The partial eclipse of the sun of March 16 was observed for last contact, and a number of dry-plate negatives were obtained.

Denmore Observatory (1885).—Mr. W. H. Numsen has erected a small private observatory near the city of Baltimore, and his 4-inch Cooke equatorial has been devoted to the study of the physical features of comets, &c. The approximate position of the observatory is, latitude +39° 21′; longitude $5^h\ 6^m\ 52^s$ west of Greenwich.

Dresden (1884) (private observatory of Baron Engelhardt).—two hundred and forty-two observations of the positions of comets, planets, and nebulæ (198) have been made with the 12-inch equatorial, besides minor observations.

Dun-Echt Observatory (1885).—Lord Crawford has published Vol. III, containing Division II, of the account of the Mauritius expedition to observe the transit of Venus, 1884. The Dun-Echt circulars have proved themselves invaluable during the year.

Dunsink.—The South equatorial has been employed as usual in observations on stellar parallax. The list of southern stars mentioned in former reports, observed with the meridian circle, has been supplemented by a list of proper motion stars.

Düsseldorf (1884).—Professor Luther discovered planet 241, Germania, during the year on his Berlin chart for 0 hours. Since 1847, 150 planets have been observed 1,233 times at Dusseldorff with the 6-inch telescope.

Ealing (Mr. Common's observatory).—Experiments in astronomical photography. Comet 1885 III, independently discovered on September 4.

Edinburgh.—The printing of the Edinburgh Star Catalogue and Ephemeris for 1830 to 1890 has been resumed, and it is now completed to 17^h right ascension.

Frankfort-on-the-Main (1884) (private observatory of Herr Eppstein).—The star gauges were continued on sixty-two nights, in 682 places, 2,714 fields, containing 25,875 stars.

Sun-spots are also regularly observed here.

Geneva (1884).—The large equatorial has been provided with a spectroscope. Besides the regular observations relating to meteorology and to chronometers, observations of comets and of the satellites of Saturn have been made.

Glasgow.—Astronomical observations during 1885 have been necessarily confined to observations of a select list of stars with the transit circle. The meteorological department has finally been put upon a satisfactory footing.

Gotha (1884).—The computations of the zone 20° to 25° of the A. G. have been prosecuted. The meridian circle is used to observe moon culminating stars and others of Mayer's Catalogue, the equatorial for planet and comet observations.

Greenwich Observatory.—The last report of the astronomer royal is for the year ending May 20, 1885, and is one of the most interesting that has appeared for several years. Transit circle: A reversion prism has been used in all observations; a comparison of the results from the reversed and ordinary observations of clock stars shows sensible differences in the case of some observers, who, perhaps, have not settled down to a fixed habit of observing "reversed" stars. For determining absolute personal equations in observations of stars and of limbs of the sun, moon, or planets, a personal equation apparatus consisting of a vertical plate, with a circular aperture 6 inches in diameter to represent the sun or moon and several small pinholes to represent stars, is placed in the focus of an object-glass of about 7 inches aperture and 50 feet focal length (which is attached to the dew-cap of the transit circle when horizontal and pointing north), and is carried smoothly by clock-work. The times of transit of the artificial objects are observed over the wires of the transit circle, and are also automatically recorded on the chronograph.

The sun, moon, planets, and fundamental stars have been observed regularly. The annual catalogue for 1884 contains about 1,370 stars.

The altazimuth has been used in observing the moon from last quarter to first quarter in each lunation.

For the determination of motions of stars in the line of sight 569 measures have been made of the displacement of the F line in the spectra of 47 stars, and 72 measures of the *b* lines in 14 stars. The observations of the last twelve months confirm the change in the motion of Sirius, which now appears to be approaching the sun at the rate of about 20 miles a second.

Photographs of the sun were taken on one hundred and seventy-three days. On only two days was the sun's disk observed to be free from spots.

In conclusion, Mr. Christie strongly urges an appropriation for an object-glass of 28 inches aperture and 28 feet focal length, to be placed upon the southeast equatorial mounting, in place of the present objective of less than half that aperture. This increased optical power is especially desired for prosecuting the spectroscopic work.

We understand that the necessary sum has been granted, and that Mr. Grubb is already at work upon the glass.

Grignon (1884) has made various observations on solar spots, comets, meteors, lunar eclipses, spots on Venus and Mars, &c., for which observations, and the conclusions drawn from them, reference must be made to the original report.

Harrow (Lieutenant-Colonel Tupman's observatory).—The meridian circle has been employed in determining the latitude and longitude of the observatory, and in observing right ascensions of the moon. The approximate latitude found is $+51^\circ\ 34'\ 47''$, and the approximate longitude, from transporting chronometers, $1^m\ 19^s\!\cdot\!9$ west of Greenwich. The equatorial reflector has been chiefly used for observations of comets.

Harvard College Observatory.—Professor Pickering's report was presented to the visiting committee December 3, 1885. The death of Mr. Robert Treat Paine has deprived the observatory of the immediate aid and advice of one of its most cordial friends, who had been a member of the visiting committee from the time of its original organization, forty years ago. Mr. Paine has perpetuated his services to his favorite science by the bequest to the observatory of his entire fortune, amounting to more than a quarter of a million of dollars. Upon the settlement of the estate, one-half of this sum will become immediately available.

The devotion of the observatory mainly to photometry continues, and the large equatorial has been occupied in observations of the eclipses of Jupiter's satellites, faint stars selected as standards of magnitude, comparison stars for variables, and of the temporary star in the nebula of Andromeda. Mr. Chandler has continued his observations with the new instrument of his invention called the *almucantar*, which in his hands exhibits, Professor Pickering says, a surprising efficiency and accuracy. The meridian photometer shows a large increase of work over previous years, the number of separate settings somewhat exceeding 50,000. The list of objects observed has been somewhat extended, and the accordance of the results continues satisfactory. The height and velocity of clouds have been the subject of study with Mr. W. M. Davis, about three hundred series of measures being obtained at a pair of stations connected by telephone. The measured altitudes varied from 2,000 to 25,000 feet. The observatory remains the American center of telegraphic distribution of important astronomical announcements, the discovery of nine small planets, five comets, and one new star being promulgated during the year. By the aid of the Bache fund of the National Academy of Sciences, an important investigation in stellar photography has been undertaken. Many photographs of the trails left by stars have been taken with the camera stationary; and an equatorial star no brighter than the sixth magnitude leaves its mark in this way, while stars much fainter near the pole will leave an impression, since their motion is slow. Stars as faint as the fourteenth magnitude have thus been photographed without clock-work to move the instrument. The trails of the faint polar stars are very well defined and minute, and afford an excellent measure of stellar brightness, besides furnishing the means of determining the stars' positions with great accuracy. Also, the attempt has been made to prepare star-charts by photography; but the most striking results have been obtained with stellar spectra. By means of a large prism mounted in front of the lens, photographs of spectra have been obtained of stars as faint as the eighth magnitude, in which lines are shown with sufficient distinctness to be clearly seen in a paper positive. As all the stars in a large region are thus obtained with one exposure, more than a hundred spectra have been secured on a single plate.

The work done with the meridian circle by Professor Rogers has largely consisted in the determination of the graduation of the instrument. The work performed for this purpose is equivalent to the reading of a microscope forty thousand times. A second revision of the zone observations between the declinations +50° and +55° is nearly completed, and the observation of a catalogue of circumpolar stars has made good progress. Many shorter series of observations have also been made. The reductions are far advanced, and material for several volumes is nearly ready for the press.

An abstract of Mr. Chandler's investigation of the latitude of the Havard Observatory in given below:

During the past winter a number of stars situated between +5° and −5° of declination were observed with the almucantar (see *Bulletin Astronomique* I, p. 37), for the purpose of a new determination of the latitude of the observatory. The observations of this winter, confirmed by a new discussion of former determinations, indicate that the latitude of the dome of the Havard College Observatory, as given in the *American Ephemeris* (42° 22′ 48″·3), or in the *Connaissance des Temps* (48″·1), is much too large. The more correct value, according to Mr. Chandler, is 42° 22′ 47″·6.

For the latitude in question, there are on hand Professor Peirce's determination, based upon a long series of observations by the Messrs. Bond (1844–'45, prime vertical transits); Dr. Gould's determination (1855, zenith telescope); a series of observations by Professor Rogers (1864, prime vertical transits) not yet published; and, finally, two series obtained by Mr. Chandler in 1883, with a small almucantar and with a portable transit instrument. We give here the collected results of these different determinations, which are quite sensibly modified by reduction to the system of Dr. Auwer's fundamental catalogue. The results of 1844, which depend upon five stars only, are much more accordant with the other results if the observations of β Persei be omitted in the reduction, β Persei giving a latitude 1″·5 less than the general mean. Mr. Chandler thinks that this star's proper motion in declination as adopted by Dr. Auwers (+0″·01) should be corrected by (−0″·03).

	No. of observations.	Latitude.	Reduced to Auwer's system.
		° ′ ″	″
Bond-Peirce	168	42 22 48.13	47.06
Bond-Peirce (excluding β Persei)	128	48.17	47.53
Gould	308	48.15	47.61
Chandler, 1883	18	47.63	47.63
Do	28	47.59	47.45
Do	85	47.57	47.57

Bull. Astron., August, 1885.

Helsingfors.—Dr. Anders Donner was appointed director to succeed Professor Krueger in 1883. The meridian instrument has been used to reobserve some 500 stars of the Helsingfors zone, +55° to +65°, Victoria and Sappho, the Moon and moon-culminating stars, &c.

Herény.—Vol. II will be published in 1885. Spectrum observations of β Lyræ have confirmed the variability of the spectrum of this star. Many other spectroscopic observations of stars, planets, and comets have been made.

Hong-Kong.—Largely devoted to meteorological observations, weather reports, &c. The new time-ball was dropped daily at 1 P. M., Sundays and holidays excepted. Observations of the moon and of Jupiter's satellites have been obtained.

Karlsruhe (1884).—The principal work of the observatory is the determination of the positions of southern stars to 8th magnitude, inclusive. In the zone 0° to $-4°$, 5,000 observations have been made, and the zone $-4°$ to $-7°$ has been commenced. The single positions have probable errors of $\pm 0^{s}\cdot 028$ and $\pm 0''\cdot 39$. The 6-inch refractor has been remounted.

Kew.—Sketches of sun-spots have been made on one hundred and seventy-six days, in order to continue Schwabe's enumeration. The rating of time-pieces and the examination of sextants, meteorological instruments, &c., is continued.

Kiel (1884).—The equatorial has been used to observe Σ 2164 for parallax, by Dr. Lamp. New comets were regularly observed. The meridian circle is used to determine the positions of stars between 79° and 82° north. The zone catalogue (55° to 65°) is in preparation.

Leipzig (1884).—A 6-inch heliometer by Repsold is in process of construction and will be delivered at the end of 1886. A universal instrument has been ordered, with which a long series for latitude will be commenced. Ten thousand five hundred and forty-one observations (123 zones) of zone stars have been made in the new zone ($+5°$ to $+10°$) and the reductions for the old zone ($+10°$ to $+15°$) are in progress.

Leipzig (1884) (private observatory of Dr. Engelmann).—Two thousand six hundred observations of 430 double stars have been made, mostly of Struve's doubles. An investigation of the constant errors is in progress. It appears that the *difference* in the magnitude of the components influenced the *constant* errors in a marked degree. Otto Struve's list of double stars for comparison has been observed; about 500 measures have been obtained.

Leyton (Mr. Barclay's observatory).—Double-star observations and observations of the phenomena of the satellites of Jupiter and Saturn are continued.

Lick Observatory.—All the buildings for the observatory proper are now completed except the dome for the large equatorial. A suitable dwelling house has been erected; others will be required. All the principal instruments of the observatory but one have been designed, ordered, constructed, inspected, and are now suitably mounted, so that observations could be at once begun. This instrumental equipment consists of a 12-inch Clark equatorial; a Repsold meridian circle of essentially the same design as the Strasburg instrument, having an object glass of 6 inches aperture, with collimators of the same size (these three objectives by Alvan Clark & Sons); a 4-inch transit instrument by Fauth; a 6-inch equatorial; a 4-inch comet-seeker by Clark; a 2-inch Repsold vertical circle; a photo-heliograph; a measuring engine by Stackpole, reading either rectangular or polar co-ordinates. There are five clocks, by Dent, Frodsham, Hohwü, and Howard, and four chronometers by Negus. A system of electrical connections unites all the clocks and observing rooms. A most wise provision is a workshop with a complete outfit of tools and lathes. An extensive library is in process of formation and has already necessitated an outlay of about $5,000.

The contract for the object glass of the great refractor, which is to have an aperture of 36 inches and a focal length of 60 feet, was placed with the Messrs. Clark nearly five years ago. Two years later they received from the glass-maker, M. Feil, of Paris, a disk of flint-glass of the required perfection, and 38 inches in diameter. After repeated unsuccessful attempts a satisfactory piece of crown-glass was cast in 1885, and sent to the Clarks, and about October the work of figuring was begun, and is now being pushed rapidly forward. The Clarks hope to have the objective finished in the autumn of 1886. It has not yet been decided, we believe, who is to make the elaborate mounting for the telescope, or the dome of about 70 feet diameter, which is to cover it.

"With regard to the prospective capabilities of the great telescope when placed in so favorable an atmosphere, it is stated that it is not unreasonable to suppose that on the best nights the maximum magnifying power (about 3,500) may be advantageously employed. Making due allowance for the unfavorable effects of the earth's atmosphere, the observer might, under these circumstances, expect to see the moon much the same as he would without the telescope, if it were only 100 miles away. It might be possible then to make out details of objects, even although they were no larger than some of the larger edifices on the earth."

Prof. Edward S. Holden, director of the Washburn Observatory, Madison, was appointed January 1, 1886, to the double position of director of the Lick Observatory and president of the University of California, to which latter institution the observatory when completed will be attached. Professor Holden, as consulting astronomer, has virtually had the direction of the work for some time past, visiting Mount Hamilton in 1881 and again in 1883 and 1884.

The first volume of the publications of the Lick Observatory is now in course of preparation, under the direction of the Lick trustees, by Capt. Richard S. Floyd and Professor Holden.

Liverpool Observatory.—Time-service and chronometer tests are continued as in previous years. The late Mr. John Hartnup was succeeded as director by his son, who bears the same name.

Lund (1884).—Dr. Dunér continues his observations of the spectra of stars, measures of double stars, and positions of the comets. The longitude observations of Dr. Dunér and Professor Thiele in 1879, lately reduced, make the Lund Observatory $2^m\ 26^s{\cdot}38 \pm 0^s{\cdot}04$ east of the observatory of Copenhagen.

McCormick Observatory.—The Leander McCormick Observatory, of the University of Virginia, was formally opened by public ceremony on the 13th of April, 1885. An address on "The instruments and work of Astronomy," was made by Professor Hall, of the United States Naval Observatory.

The 66^{cm} (25·98 inches) equatorial of the observatory is chiefly employed at present in observations of nebulæ. During the progress of this work something over two hundred new nebulæ have thus far been detected by Professor Stone and his assistant, Mr. Leavenworth. Drawings of about the same number of nebulæ (some old and some new) have also been made. Professor Stone designs making a special study of the nebula of Orion.

McKim Observatory.—The McKim Observatory was opened in September, 1885, as a department of De Pauw University. It is located in the suburbs of the university town, Greencastle, Ind., in west longitude from Greenwich 86° 37½′, north latitude 39° 37′. The building and the full instrumental experiment which it is designed to have are the gift of Mr. Robert McKim, of Madison, Ind. This gentleman has for a number of years had a 6-inch glass mounted near his residence, so that the observatory he has just presented to De Pauw University might almost be called the *second* McKim Observatory.

The equatorial has a clear aperture of 9·53 inches; the dome is of iron, and is 17 feet in diameter. Both telescope and dome are by Warner and Swasey, of Cleveland. For clock errors an almucantar is to be used. The building and instruments have cost $8,000, and about $2,000 more will be expended. Dr. T. P. John is the director.

Madras.—From the report for 1883 we learn that 2,453 observations were made with the meridian circle during the year, making a total of 50,878 Only a few hundred more are required to finish the catalogue of over 5,000 stars. The publications are badly behindhand.

Melbourne.—Mr. Ellery's nineteenth annual report states that the new transit circle of 8 inches aperture was received in May, 1884, and mounted early in July. It is proposed to send the two specula of the great reflector, one after the other, to England to be repolished. A number of stars selected by Auwers was observed with the old transit circle to assist in the formation of a fundamental catalogue of southern stars.

Mexico Observatory.—Prof. H. S. Pritchett, director of the observatory of the Washington University at Saint Louis, kindly communicates the results of a longitude campaign between his observatory and the Observatorio Nacional de Mexico, Sr. A. Anguiano, director. A preliminary discussion gives $35^m\ 57^s.25$ as the difference of longitude, or $6^h\ 36^m\ 46^s.41$ west of Greenwich as the resulting longitude of the transit-circle piers of the Mexican observatory. This differs $5^s.0$ from the old value determined by moon-culminations. The circuit was 2,583 miles long, with five repeaters, and the armature time was quite constant, averaging $0^s.38$. The outfit of the Mexican National Observatory includes a 15-inch equatorial by Grubb, and an 8-inch meridian circle and a 6-inch transit, both by Troughton and Simms. The *personnel* consists of the director (Sr. Anguiano) and five assistants. (*Science*, November 6, 1885.)

Milan (1884).—The 8-inch refractor has been used for measurements of 255 double stars and for observations of comets. The measures of the ellipticity of Uranus cannot yet be considered free from all objections. The observations on Mars seem to confirm previous results as to the duplication of canals, &c.

The large dome for the 18-inch refactor is nearly completed.

Munich (1884).—The 10-inch equatorial is now remounted and the Repsold micrometer has been studied. It will be principally used to determine the parallaxes of Ll. 28298, 26 Draconis, Gr. 2875, Br. 3077.

The Munich zones contain 34,000 stars, of which 9,800 require reobservation. This will be accomplished in zones 6° broad. The old Munich zones are recomputed and a catalogue (for 1880) is in preparation.

Natal Observatory (1884).—Fifty-nine transits of the moon's limb and 50 transits of the nearly central crater Murchison A have been obtained with the transit circle. These observations furnish data for calculating the variation in the irradiation at the edge of the moon and of the effect of the known irregularities on the limb. Arkley Observatory, England, co-operates in this work. An appendix to the report contains observations of comets Pons and Barnard.

Nice.—The observatory and its extensive grounds occupy the summit of a hill known as Mont Gras, some 1,200 feet above sea level and distant from the Mediterranean about 3 or 4 miles. We notice that it is arranged on the plan of detached buildings, a plan that has been followed in the construction of most large observatories of recent date. On the southern slope of the hill are the dwelling houses for the observers, library, computing rooms, &c., and higher up are the various buildings that contain the instruments. A 15-inch equatorial, 6-inch meridian circle, and 3-inch transit are already in use. The great steel dome, 72 feet in diameter, is finished and has been found to work satisfactorily. The peculiarity in the construction of this dome—the work of the celebrated engineer Eiffel, of Paris—is that the greater part of its weight is taken by a circular float which revolves in an annular tank filled with a solution of chloride of magnesium in water. This solution has a density of 1·25, and is able to resist a temperature of 40°

centigrade below zero. Running-wheels are used as guides and to take such a share of the superimposed weight only as may be necessary to secure perfect steadiness in rotation. It is evident that by adding to the water in the tank the weight on the wheels can be either entirely or partially relieved, and by abstracting from it, any desired pressure can be placed upon these wheels. The shutter is made in two leaves, and opens right and left with a rain-tight joint in the center; the opening is about 10 feet. For a complete description of the dome, with illustrations, we must refer to *L'Astronomie*, 4 : 206–12; *Observatory*, 8 : 290; and *Nature*, 32 : 62, 297.

M. Faye announces that the objective of 30 inches clear aperture has been finished by the Henry brothers, and has been sent to Gautier, who has charge of the construction of the great equatorial; it is hoped the instrument will be mounted in April, 1886.

O'Gyalla.—Sixteen hundred and ten observations for the spectroscopic *Durchmusterung* of the southern sky have been made. Color observations with the Zoellner photometer are also continued, as well as various other photometric and spectroscopic series.

Oxford University Observatory.—The director's annual report was read on June 3, 1885. A subsidiary observatory, for instruction, has been built. Professor Pritchard has published a memoir on the evidences of mutual gravitation among the components of the Pleiades. The completion is announced of the phometric survey of all stars visible to the naked eye from the pole to —10°.

Paris.—Rear-Admiral Mouchez has issued his report on the work of this establishment during the year 1884. The completion of the reobservation of Lalande's stars has led to a new disposition of the meridian instruments, one of which, on the proposal of M. Lœwy, is now occupied with the determination of a number of circumpolar stars on his new method; the great meridian circle and the circle of Gambey are still employed for observations of the minor planets and of comparison stars for planets, comets, and nebulæ observed with the equatorials. The great telescope of $0^{m}\cdot74$ is still unmounted, no suitable position being available in the present state of the grounds of the observatory. M. Mouchez mentions having received communications from the authorities in Algeria, referring to the possibility of obtaining from the local budget the greater part of the sum that would be required to mount the instrument at the observatory of Algiers on the summit of the Boudjaréah, an exceptionally favorable situation, which might be visited by the astronomers of the Paris Observatory for special observations, but the council of the latter institution have not availed themselves of the proposition, in the hope that the equatorial may yet be erected at Paris. Amongst the observations made with the instruments in the west tower and the Henry equatorial are many of the satellites of Uranus and Neptune, the companion of Sirius, the belts of Uranus, nebulæ, and double stars. MM. Henry have been occupied with astronomical photography during the year, and, as is well known, with great success; various clusters of stars have been photographed, and M. Mouchez appends to his report a reproduction by heliogravure of a plate of the great clusters in Perseus. A trace of the motion of the minor planet Pallas was shown after an exposure of thirty-five minutes. The important results obtained by MM. Henry in photographing very small stars in those crowded parts of the heavens where the galaxy crosses the ecliptic have been already referred to. - - - Steady progress has been made, both with the calculations and printing of the Paris Catalogue of Stars, and it is expected that the first volume of both series (star positions as observed, and catalogue) will be completed by the end of the year. Vol. 18 of the *Mémoires* is finished. The report further details the personal work of the members of the observatory staff. Amongst the additions to the museum is a portrait of Pons, presented by M. Tempel.

The report for the year 1884 is preceded by one which enters specially into the present condition of a scheme for removing the principal instruments in the observatory to a site where not only greater steadiness can be secured in their mounting, but where the objections of being surrounded by a great city will not exist. It appears that the Academy of Sciences have not, so far, favored this scheme. M. Mouchez states very clearly his view of the question. (*Nature.*)

Potsdam.—Researches are in progress on a new determination of the wave-lengths of a large number (300) of the Fraunhofer lines; on the influence of temperature on the refraction and dispersion indices of fixed substances; on the reflective power of various substances; on the absorption-spectra of such substances as are used in photography, &c.

Jupiter and Mars were regularly observed and the nebulæ observations are concluded.

The photometric measures embraced long series of determinations of the brightness of the major planets and of seven of the asteroids. Many variable and red stars were also measured. Determinations of the brightness of stars by photography have also been made, and a number of photographs of clusters have been taken.

"The first part of the fourth volume of the publications of this observatory, which was published in the latter part of last year [1885] contains three papers. The first of these is by Professor Vogel, and contains the observations which he made with the great Vienna reflector in 1883 for the purpose of testing the performance of the great object-glass. Professor Vogel's final verdict is altogether favorable. 'The Vienna objective,' he says, 'leaves nothing to be desired as regards the precision of the images,' and he speaks of using with advantage a power even of 1,500 upon planetary markings, a statement which is illustrated by a sketch of part of Saturn's ring as seen with that magnifying power.

His principal observations were, however, spectroscopic, Professor Vogel utilizing the great light-gathering power of the Vienna equatorial for a detailed examination of the remarkable spectra shown by several faint stars, classified by him under Types II *b* and III *b*. - - - The paper also contains a number of observations of nebulæ, principally planetary, and is illustrated by four lithographic plates. The second paper contains meteorological observations made in the years 1881 to 1883, and the third is a very careful investigation by Dr. G. Müller of the influence of temperature on the refraction of light through prisms of various kinds of glass, of Iceland spar and rock crystal." (*Nature.*)

Prague (private observatory of Professor Safarik).—Fourteen hundred and eighty-two observations of 92 stars were made in 121 observing nights.

Pulkowa Observatory.—"We have received M. Struve's annual report, presented May 25, 1885, on the work of the observatory during the year. The great 30-inch refractor had not yet been brought regularly into use; but at the time of writing the report observations with it were to be commenced immediately. The observations with the 15-inch equatorial, which for the last forty-five years have been M. O. Struve's own special work, are now undertaken by his son, Hermann Sturve, as he himself has been too much occupied with other work, as well as having been incapacitated by a long illness. Micrometrical measures (98 in all) of the relative positions of Iapetus and Titan, Titan and Rhea, and Rhea and Dione have been made during the year. It is hoped that these measures, in combination with those made in former years, will furnish very accurate elements of the orbits of these satellites. Dr. Hermann Struve has also made observations for determination of the parallaxes of 10 stars, as well as determinations of the positions of Encke's and Wolf's comets. The relative positions of 116 faint stars, which were occulted by the moon during the total eclipse of October 4, 1884, have also been determined with this instrument. Observations with the great transit instrument have been continued by Wagner, with Wittram as his assistant. The observations (2,348 in number) have chiefly been of the Pulkowa *Hauptsterne.* With the vertical circle Nyrén has zealously pursued his work of determining the declinations of the *Hauptsterne.* Of the 895 observations made during the year, no fewer than 832 were made in both positions of the instrument. In addition to these, 103 observations of the sun were obtained. Romberg, observing with the meridian circle, has obtained 1,236 observations in both elements of different stars taken from, (1), the Åbo Catalogue; (2), the Pulkowa Catalogue of Double Stars; (3), stars used for comet observations; (4), stars used for determining the scale of the heliometer. With the 4-inch Repsold heliometer Backlund has obtained thirty-two measures of distances and thirty measures of position-angles of Jupiter's satellites. Lindemann has investigated the variation of light of V Cygni with the Zöllner photometer (*Observatory*, No. 104, p. 435), and also has observed some other stars, the variability of which has been suspected. Hasselberg's spectroscopic researches have been limited to the chemical elements, nitrogen and hydrogen, which, however, are not yet finished. Photographs of the sun have been regularly taken throughout the year, for which work gelatine plates have been found specially conveneint. During the year 220 photographs have been obtained on 173 days. Referring to the work carried on at the Marine Observatory at Nicolajew, M. Struve remarks that the director has found at Batum an extraordinary deviation of the plumb-line, amounting to 49″·6 in longitude=37″·1 of a great circle in the direction of the prime vertical. In latitude the deviation is 16″. That no volume of Pulkowa observations has been published during the year is owing chiefly to the long illness and multitudinous occupations of the director. The following volumes, however, are in active preparation: Volume VIII, which contains the star catalogue compiled from the meridian observations, 1839 to 1869; volume X, containing the continuation of O. Struve's measures of double stars; volume XII, containing the fundamental determinations of R. A. for 1865.0; and volumes XIII and XIV, containing the fundamental determinations of declination for the same epoch. The work of the geographical and geodetical bureau, under Döllen's superintendence, has also been carried on as usual during the year." (*Observatory.*)

Radcliffe Observatory, Oxford.—With the transit circle 3,500 observations of transits have been made, and 3,440 circle observations. The volume for 1882 has been printed; that for 1883 is nearly ready for press; the observations for 1884 are completely reduced; those for 1885 are nearly reduced to the end of the year.

Rome.—A new observatory is being built under the direction of Father Ferrari, S. J., formerly assistant, and successor of Father Secchi, in the observatory of the Roman College. The observatory is now in possession of a 4-inch equatorial by Merz, and is to have a 10-inch by the same maker. (*Sid. Mess.*, 4 : 313.)

Rosse (*Earl of*), Birr Castle, Parsonstown.—Attention has been given to photometry and the measurement of lunar heat. The driving-clock of the 6-foot reflector is now run by water power.

San José, Cal.—The recently completed observatory for the University of the Pacific, at San José, has a 6-inch Clark equatorial, and a Fauth transit instrument. The dome is 12 feet in diameter inside, covered with galvanized iron, and requires 15 pounds to turn it. The building and instruments are the gift of Capt. Charles Goodall, of San Francisco, and Daniel Jacks, of Monterey. The observatory is under the charge of Prof. J. C. George.

Smith Observatory.—We are very glad to learn that the reported closing of the Smith Observatory of Beloit College on account of lack of funds is incorrect. Mr. Tatlock has been succeeded as director by Mr. Charles A. Bacon. New arrangements have been made for both meteorological and astronomical observations, and special attention will be given to solar and spectroscopic work.

Stonyhurst College Observatory.—Magnetic and meteorological observations have been made in 1884, as during the past fifteen years. On 257 days drawings of the sun were made; the entire chromosphere was measured on 88 days, and spectra of spots were obtained on 36 days. "The glow encircling the sun during the day has never been entirely absent, though it varied in intensity from time to time." - - -

*Strassburg.**—Dr. W. Schur has published his report of the work done at the observatory during the last year. The instruments in use at Strassburg are, (1) the meridian circle; (2) the altazimuth; (3) the great 18-inch refractor; (4) heliometer, and (5) the 6-inch refractor. It would appear, however, that to work these numerous and excellent instruments Dr. Schur has only two assistants. The meridian circle has been chiefly employed in observing stars for the southern zones of the *Astronomische Gesellschaft*, as well as in determining positions of the sun, moon, and large planets and miscellaneous stars, comet-stars, &c. Determinations have also been made of the errors of division of the circle and of the form of the pivots. With the altazimuth, to which Herr Schur appears to have devoted a considerable amount of time and attention, observations of the moon have been commenced. The great refractor has been used for observing comets, and a re-examination of the micrometer-screw shows the necessity of a correction to the results which have been already published. With the heliometer a number of measures of the sun's diameter have been made; whilst the 6-inch refractor has been employed in making a series of measures for the determination of the parallax of ψ^5 Aurigæ. The amount of work performed by Dr. Schur and his assistants is very creditable to them; but at the same time we are constrained to remark that it is a misfortune that an observatory which is so well provided with instruments should not have a larger observing staff, in order that the various instruments might be worked adequately and to the best advantage. (*Observatory*, October, 1885.)

Taschkent.—The main object of the observatory is to co-operate in the surveys and explorations of Turkestan. Four latitudes and longitudes were determined in 1884. Comets, asteroids, and solar-spots have been observed also.

Temple Observatory, Rugby.—The spectroscopic measurement of the motions of stars in the line of sight has been continued, and a new instrument with prisms of bisulphide of carbon—intended for this work—is nearly completed. Double stars measures have been made as in former years, and a catalogue of 900 sets of measures has been published in the Memoirs of the Royal Astronomical Society.

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* *Astron. Nachr., No.* 2675.

United States Naval Observatory.—The report of the Superintendent bears the date of October 5, 1885. Rear-Admiral S. R. Franklin, U. S. Navy, was detached March 31 and ordered to the command of the European squadron. From that date to the 1st of June Commander A. D. Brown acted as Superintendent, when he was relieved by Commodore George E. Belknap.

The 26-inch equatorial, in charge of Professor Hall, has been employed on satellites and double stars. The dome, 43 feet in diameter, is now revolved with great ease by means of a 4 horse-power gas engine. The observations of the satellite of Neptune and those of the two outer satellites of Uranus have been discussed and the results published. The observations of Iapetus have been published since the report closed.

The transit circle has been employed in the same class of work as in the preceding years. Since the last report 5,520 observations have been made. Of these, 90 were of the sun, 70 of the moon, 156 of the major planets, and 64 of the minor planets.

The 9·6-inch equatorial: Professor Frisby was placed in charge April 2, 1885. The work of the instrument has been confined to: (1) Observations of comets, six of which have been systematically observed during the year. These observations have all been reduced to date, and published in various astronomical journals in this country and Europe. (2) Observations of asteroids, principally of such as could not be observed with the transit circle on account of their faintness or their position; thirty-five regular observations of asteroids were made, and twenty-one approximate positions of other asteroids obtained, so that they could readily be observed with the transit circle. (3) Occultations of stars by the moon, whenever practicable. (4) Doubtful observations of stars and asteroids made with other instruments were looked up and decided, this being probably one of the most important uses of the equatorial. A few observations have been made of the variable star in the nebula of Andromeda, which show that the star is decreasing in brightness. Assistant Astronomer Winlock has made several observations of comets, with drawings of their physical peculiarities and changes of appearance.

The prime vertical instrument: The work of reducing the observations made in 1883–'84 by Lieut. C. G. Bowman and Ensign H. Taylor, U. S. Navy, for the determination of the constant of aberration, has been pursued. In July of last year a communication was received from the president of the International Geodetic Conference, asking the cooperation of this Observatory with the Royal Observatory at Lisbon in the determination of the problem of the change of latitudes, the observations to be taken with the prime vertical instruments of the two observatories. Communication was opened and correspondence is still in progress with the director of the observatory at Lisbon, and preparations have been made to undertake the work here very soon after it is known that it will be begun at Lisbon.

Meridian transit instrument: The work has consisted principally of daily observations and reductions for clock corrections in connection with the time service.

Time service: During the past year the demands upon the time service have greatly increased. In Washington, the number of clocks of the Gardner system in the various public offices has increased from 20 to 84. The total number of time-balls now dropped by the Observatory signal is eight, at the following points: Philadelphia, Baltimore, New Orleans, at branch hydrographic offices; New York, Western Union building; Navy Department, Washington; navy-yard Washington; Hampton Roads; Savannah. A ninth will soon be added at the torpedo station in Newport.

The branch observatory at Mare Island, which is fitted with a duplicate of the transmitting apparatus of this Observatory, has been connected with the mainland by a cable, and time signals are transmitted daily along the Pacific coast. A time-ball has been erected on the island for the benefit of the Vallejo shipping, and is dropped daily at noon of the one hundred and twentieth meridian. The Hydrographic Office time-ball at San Francisco is also dropped at the same instant by signal from the Mare Island Observatory.

Photography: In the programme of work proposed for the current year it was stated that the work of taking sun photographs daily would be inaugurated as soon as practicable. The work of the Transit of Venus Commission has up to this time prevented any regular system being adopted.

During the year the names of 1,408 visitors have been recorded, and 1,137 permits were issued for night visitors, for whose accommodation the small equatorial is set apart.

The records kept by the several observers and watchmen show that only about one night in eight is good for observing, while an exceptionally good night for astronomical work cannot be reckoned upon much oftener than once a month.

The Commodore renews the recommendations of his predecessors that the Observatory be removed* to the new site purchased in 1880, and that a board of visitors be appointed to visit the institution annually.

A special report of Professor Harkness is added, giving the progress of the work of the Transit of Venus Commission.

Upsala.—The unpublished observations of nebulæ and clusters up to 1880 are now prepared for the press. With the Zoellner photometer it is proposed to determine the magnitudes of the comparison stars used by Argelander, Schoenfeld, and Oudemanns for variables.

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*A committee of the National Academy of Science has, at the request of the Secretary of the Navy, given careful consideration to this question. Their report may be found in *Senate Executive Document No.* 67, 49*th Congress,* 1*st session.*

Warner Observatory.—The 16-inch refractor has been used for the past three years mainly in the search for new nebulæ. A catalogue of some 200 faint nebulæ has been published.

Washburn Observatory.—"The third volume of the 'Publications of the Washburn Observatory,' lately issued, gives the results of the work of 1884. About 1,800 observations were made with the Repsold meridian-circle upon the Gesellschaft southern fundamental stars and the Leyden Cape of Good Hope refraction-stars. The instrumental constants are given for each observing day, and an investigation of the zenith-distance micrometer-screw and of the horizontal flexure of the instrument. In the cold winter weather of Wisconsin the micrometer-springs turned out too weak to pull the slides, and had to be replaced with stiffer ones. The probable error of a single declination is now reduced to 0″·4, a great improvement over that noted in vol. II.; and a correction of +0″·30 ± 0″·026 to the constant of the 'Pulkowa refractions' seems to be called for by the observations of 1884 to suit the atmosphere over Madison. Professor Holden expresses his continued satisfaction with the Repsold meridian-circle, and appears to be making a very thorough study of it; and in this his example might well be followed with profit by some of our older established observatories. Two determinations of the latitude by Mr. G. C. Comstock are given—one from Professor Holden's and his own observations with the zenith-telescope, the other from his own with the prime-vertical transit, using both reflected and direct observations; the declinations in both cases being those of Auwers' system. They come out respectively +43° 4′ 36″·97 ± 0″·07 and +43° 4′ 36″·99 ± 0″·06, remarkably accordant results. The fifth part of the volume is a 'Catalogue of 1,001 southern stars for 1850·0 from observations by Signor P. Tacchini, at Palermo, in the years 1867, 1868, 1869,' by Rev. Father Hagen, S. J., and Edward S. Holden. The original observations had never been reduced to mean place, but being good ones and in a part of the sky where needed, we have here the anomaly of European work reduced and published in this country; and Father Hagen and Professor Holden are to be highly commended for making it available, while its comparison with Oeltzen's Argelander (south) and the Washington zones served to detect many errors in these catalogues. The sixth part gives the observations of 437 southern stars made with the Washington transit-circle, and also the position of the same stars (whenever occurring) from the catalogues of Yarnall, Gould's zones, and Stone, all the positions being reduced to 1850.0 by Father Hagen. This is the first opportunity for easy comparison on a large scale between these four systems of southern declinations, and the comparison develops the following important differences of north polar-distance:—

Washington—Yarnall = +1″·12 (from 220 stars).
Washington—Gould (Z. C.) = +1″·96 (from 215 stars).
Washington—Stone = +1″·00 (from 238 stars).

- - - "The volume closes with a count of the *Durchmusterung* stars between —2° and +13°, a determination of the constants of some of the other instruments, meteorological observations for 1884, a summary of the same as taken at Madison continuously from 1853 to 1884, and is throughout a highly creditable publication." - - - (*Science*, November 20, 1885.)

Willets Point Observatory.—The astronomical observations made during 1885 were of the same nature as those described at some length for the preceding year in the "Account of the Progress in Astronomy in 1884." The observatory is established for training engineer officers in the applications of practical astronomy to geodesy. The course of instruction, as well as the arrangement of the observatory building and its equipment (described and illustrated with a plan of the observatory in *General order* No. 3, series of 1881, and *Printed order* No. 3, series of 1882), may well be taken as a model in this branch of astronomy. A large number of latitude observations made by different observers from 1880 to 1884, and apparently showing a steady decrease in the latitude of the post, has been submitted to a critical discussion by Miss Alice Lamb, of the Washburn Observatory. By selecting the best determined stars, and by rejecting the observations with one of the instruments, and the work of some observers, whose probable errors are about twice as large as the probable errors of those whose work is retained, she concludes that there is strong reason to attribute the systematic change to errors of observation rather than to a real diminution of the latitude.

Yale College Observatory.—The following is a brief statement of the work accomplished or in progress under the direction of Dr. W. L. Elkins, who has charge of the heliometer, the only instrument of that class, we believe, in operation in this country.

The principal object of research has been the triangulation of the Pleiades, to which work the instrument was devoted from September, 1884, to March, 1885. It was originally intended to confine the investigation to the stars measured at Königsberg; the scheme has been extended, however, to include all the stars in the Bonn Durchmusterung, within certain limits, down to the magnitude 9·2, making sixty-nine stars in all. The reductions are in a forward state.

Other observations are reported:

Measures of the Moon from neighboring stars, diameters of the Moon, diameters of Venus, and the outer ring of Saturn, and a series of observations of Titan referred to its primary, which is being continued by Mr. A. Hall, jr.

There have been various additions made to the working appliances of the instrument. The oil-lamps illuminating the scales and circles have been replaced by half-candle incandescent lamps. The most important addition is, however, the registering micrometer, which Messrs. Repsold have made for reading the scales. The principle consists in impressing on a Morse fillet the figures and divisions of the micrometer head along with those of a fixed index.

The instrument is now being devoted to systematic investigations in stellar parallax, and work is progressing, which will furnish, it is hoped, reliable values of the parallaxes of the ten stars of the 1st magnitude in the Northern Hemisphere referred to neighboring stars of about the 8th magnitude.

Zurich.—The sun-spots are assiduously observed here. The maximum occurred in December, 1883, to January, 1884.

ASTRONOMICAL INSTRUMENTS.

Wire-gauze screens as photometers.—"Of late years the use of wire-gauze screens, one or more in number, over objectives has come into use for several purposes. Over one of the halves of a heliometer-objective they are used to reduce the image of a bright star to approximate equality with that of a fainter star from the other half, an essential condition for the most accurate superposition of the two images. With a meridian circle they are used to reduce the brighter stars to an approximate equality with the faintest that can be observed with satisfactory precision, or to investigate the difference of personal equation for different magnitudes by taking different tallies of transit-wires, with screen off and on, at the same transit. In the latter case Professor Holden points out the necessity (*Astron. Nachr.* 2690) of changing the illumination of the field with the change of screen, so that each magnitude may show against its customary degree of color or brilliancy of background. Such screens may also be used for photometric purposes when once their coefficients of transmission have been determined. Those having occasion to use them in this way will do well to consult a paper by Professor Langley (*Amer. Journ. Sc.*, xxx, 210) on this subject. In this it is shown that the effective transmission coefficients are decidedly different according as the luminous image is an extended surface or practically a point like a star. In the latter case there is a central image surrounded by a system of diffraction images, into which a large part of the light goes; so much so, that Professor Langley found that a screen (of which one and two thicknesses transmitted ·47 and ·21 respectively of the full light upon a surface) gave only ·18 and ·02 for one and two thicknesses, respectively, when measured by the brilliancy of the central image of a small pin-hole as a source of light." (*Science.*)

The defining power of telescopes.—Quite a warm discussion has been going on in the columns of the *Observatory* and *Sidereal Messenger* on the relative merits of small and large telescopes for the study of planetary detail. The controversy seems to have arisen from a statement by Mr. Denning to the effect that "apertures of from 6 to 8 inches seem able to compete with the most powerful instruments ever constructed." The true state of the case appears to be given in a note by Professor

Young (*Observatory*, VIII: 173, May, 1885): "On the whole, I find also true what Mr. Clark told me would be the case on first mounting our 23-inch instrument, *that I can almost always see with the 23-inch everything I can see with the 9½-inch, under the same atmospheric conditions, and see it better;*—if the seeing is bad, only a little better,—if good, immensely better. The only exceptions are in the case of objects which require a very low power, lower than any that can be obtained with the eye-pieces of the large telescope."

The great Pulkowa refractor.—"M. Struve was chiefly occupied during the year with work incidental to the installation of the great 30-inch refractor. It was anticipated that by September, 1884, things would be in such a state that it would be possible to begin to observe with this gigantic instrument; but, owing to various delays, chiefly connected with the construction of the dome, it was not until the end of September that the Repsolds could be invited to come to Pulkowa to superintend the work of erecting the telescope; this was accomplished very successfully by them in about three weeks. And M. Struve expresses himself as greatly pleased with the ease with which the telescope can be set, with the equality of the illumination on all its parts from a single lamp, with the accuracy with which the driving-clock performs, and with the facilities for altering the telescope into a powerful spectroscope; so that this great instrument may be regarded as the successful outcome of the highest skill of modern art in this department. Further work on the dome was interrupted by the approach of winter. - - - At present the dome is moved by hand; it is hoped, however, that this may eventually be done by electricity, and that a motive power will thus be obtained sufficient to overcome the hindrances to the rotation of the dome arising from snow and frost. From investigations made by H. Struve it appears that the position of the polar axis is correct to a fraction of a minute, that the change in focal length of the instrument during the winter is but trifling, and that, notwithstanding the great weight of the object-glass and of the eye-end, the flexure of the telescope is so small as to be practically insensible. M. Struve proposes to use the great refractor for observing such double-stars as are beyond the reach of the 15-inch equatorial, and to undertake observations of certain interesting nebulæ, as well as spectroscopic researches on stars in cases where the great optical power of the instrument will make the observations of special value." (*Observatory.*)

"Science" (VI: 306) publishes a letter from Dr. Otto Struve to Alvan Clark & Sons, from which we make the following extract: "I am asked by the Government to inform you that, in acknowledgment of the excellent performances of the great object-glass furnished for Pulkowa by your firm, His Majesty the Emperor has been graciously pleased to confer upon you the golden honorary medal of the empire. The value of this gift is enhanced by the circumstance that this medal is given very rarely and only for quite extraordinary merits. You and Repsold are the first who will receive it from the present Emperor, Alexander III." - - -

"You will be pleased to hear that with the 30-inch refractor in good nights all the most difficult double-stars discovered by Burnham with the Washington refractor can be easily measured."

Illumination by means of the electric light.—In regard to the application of electricity to illuminating the microscopes and field of view of a large fixed instrument, Dr. Gill, of the Cape Observatory, says: "Electric illumination by small incandescent lamps has been applied with complete success to the microscopes and field of the great theodolite with which the azimuth observations are made. The electricity is supplied to the lamps from a storage battery, which is charged during daytime two or three times a week by a small Grove battery. The success of the experiment has been complete. The whole arrangement is so simple, clean, and convenient, and the advantages to accuracy of observation by perfect uniformity of light, freedom from flicker, glare, and heat can only be fully appreciated after trial."

*Method of supporting a mercury trough for reflection observations.**—"The observation of the nadir has hitherto been almost impossible at the Paris Observatory, owing to the disturbance of the mercury caused by the traffic in the neighboring streets. Lately, however, M. Gautier has devised a very simple arrangement by which this is obviated. The new apparatus consists of two cylindrical basins placed one above the other, the lower one, which contains the supply of mercury, having a slightly larger diameter than the upper. The bottom of the lower basin is pierced at its center to admit a screw which projects in a vertical direction into the inside and is fixed in that position. A cylinder, fixed as an axis to the bottom of the smaller basin, is tapped to fit the projecting screw, and thus, by turning this basin round its axis, it can be raised or lowered in the larger vessel so as to obtain a supply of mercury in it (by means of an opening provided for the purpose) sufficient for observation, whilst the oscillations of the ground, Admiral Mouchez states in the paper before us, are completely counteracted by the 'demi-flottage' of the second basin." (*Observatory.*)

Hough's printing chronograph.—At the Ann Arbor meeting of the American Association, Professor Hough read a paper on the printing chronograph that he has invented. He has given a description of the instrument in his report as director of the Dearborn Observatory for 1885. The instrument is designed to print on a fillet of paper, minutes, seconds, and hundredths of seconds, indicated by the clock which controls it, at any instant that an observing key is closed by the observer's finger. The impression is made from the surface of three continuously running type wheels, the swiftest of which revolves once per second. The recent improvements consist in engraved type on the face of the wheels in place of the rubber ones used at first, and of the substitution of a direct blow by an electro-magnet upon the type-wheel fillet, thus making the apparatus much more light and compact than the old form. The mean of the seconds and hundredths may be taken directly on the fillet without transference to books. Professor Hough states that the instrument has proved perfectly reliable.

**Bull. Astron.*, 2 : 549; also (abstr.), *Eng. Mechan.*, 42 : 488.

Flexure of transit instruments.—At the same meeting of the American Association a paper was presented by Professor Harkness on the general subject of the flexure of transit instruments. Professor Harkness's thorough investigation of this subject has just been published as Appendix III to the "Washington Observations" for 1882.

Optical works of Feil & Mantois.—We learn from *L'Astronomie* that M. Charles Feil has, after some years' absence, returned to the active management of his celebrated manufactory of optical glass in Paris, the new firm being "Feil père et Mantois." M. Feil is grandson of M. Guinand, the founder of the house in 1827. The new firm succeeded in obtaining a crown disk of the requisite size for the Lick 36-inch glass, having already furnished to MM. Henry the disk for the 30-inch objective for the Nice Observatory.

Micrometer.—Mr. Chandler contributes to volume 11 of the Memoirs of the American Academy a valuable paper on the "Square-bar micrometer."

MISCELLANEOUS.

Astronomical prizes.—The Lalande prize of the Paris *Acadèmie des Sciences* has been decreed to M. Thollon for his great map of the solar spectrum. This map, which has so far demanded four years of uninterrupted work, extends from *A* to *b*, and contains 3,200 lines, 900 of which M. Thollon has been able to identify as of telluric origin. The Damoiseau prize is reserved, no memoir having been offered for it. The subject proposed is the same as in former years—a revision of the theory of the satellites of Jupiter, a discussion of observations with special reference to the direct determination of the velocity of light, and lastly, the construction of particular tables for each satellite. The Valz prize has been awarded to Dr. Spörer for his researches on sun spots, his discovery of the striking relationship between the distribution of the spots in latitude and the epochs of their maxima and minima receiving special notice. (*Nature.*)

The award of the Draper medal, made for the first time, was most appropriately bestowed on Prof. S. P. Langley, of Allegheny, for his researches and discoveries in solar radiation.

The Warner prizes awarded in 1885 were two, of $200 each, to Mr. E. E. Barnard, for the discovery of Comet 1885 II, and Comet *e* 1885, and two, of $200 each, to Mr. W. R. Brooks, for the discovery of Comets 1885 III, and 1885 V. Mr. Warner has just given four prizes, aggregating $450, for essays on the remarkable "red sunsets" which have been prevalent during the past few years, and medals have been awarded to a number of other competitors. The total amount that has been awarded by Mr. Warner for astronomical prizes since 1880, including a small amount for the expenses of judges, is $3,750. The Warner comet prize is continued from March 1, 1886, to March 1, 1887. It is reduced to $100, but is open to the world.

On the apparent increase of size of the sun, moon, and constellations when seen at the horizon. (*From the Bulletin de l'Académie royale de Belgique.*)—"The apparent increase of the diameter of the sun or moon is ordinarily attributed to the elliptical form of the celestial sphere. According to the author this explanation was given as early as the eleventh century in the Optics of Alhazen. But by experiments, comparing in a dark room the distances of two electric sparks at the height of the eye and near the ceiling, M. Stroobant was led to the conclusion that any object seen in the zenith appears only eight-tenths as large as when seen at the horizon. But there is another factor which should be taken into account, that is, the variable brightness of the star. The author thinks that a special study should be made of these very interesting physiological phenomena." (*Bull. Astron.*, April, 1885.)

Sammlung populaerer Astronomische Mittheilungen.—The eminent director of the Berlin Observatory Herr Foerster, has collected in this volume a series of scientific notices of a popular character, which have appeared since 1880 in successive volumes of the official calendar (*Normal-Kalender*). It contains a clear exposition of the state of our knowledge of the fixed stars, their distances, and their distribution in space; an article upon the limits of our perceptions of celestial objects; some interesting remarks upon the auroras, the zodiacal light, and the recent comets. In reviewing these notices, we are struck with the multiplicity and the importance of the problems offered us by modern astronomy, and are tempted to ask, with Herr Foerster, if the number of those at work at these problems is not becoming too small for the task.

An index to astronomical literature.—The need of some systematic index to the current literature of astronomy (to say nothing of the desired extension of the Royal Society's catalogue, or the completion of Houzeau's work) is more strongly felt year by year; and the difficulty is aggravated by the poor and insufficient indexes furnished with most astronomical publications. General periodical literature is provided for by Poole's Index, which is kept up to date by the Co-operative Index to Periodicals; and a committee of the American Association on indexing chemical literature reports each year favorable progress. It seems highly desirable that some similar co-operation should be organized among astronomers.

ASTRONOMICAL BIBLIOGRAPHY, 1885.

Following is a list of the principal books of the year, compiled largely from the excellent *Naturæ Novitates* of R. Friedländer & Sohn, Berlin. Reprints from transactions and periodicals are frequently included. The prices quoted are in German marks (4 marks equal to $1, very nearly), and are those given by Friedländer.

Acta Mathematica.—Zeitschrift, hersg. v. G. Mittag-Leffler. Bd. 5. Stockholm, 1885. 4to. 12

——— Same. Bd. 6. 12

Addresses at the complimentary dinner to Dr. Benjamin Apthorp Gould. May 6, 1885. Lynn, 1885. 40 p. 8vo.

Airy (G. B.).—Gravitation; an elementary explanation of the principal perturbations in the solar system. 2 ed. London, 1885. 186 p. 8vo. 7.80

Albrecht (Th.).—Bestimmungen der Länge des Secundenpendels in Leipzig, Dresden u. dem Abrahamschacht bei Freiberg, in den Jahren 1869–71 ausgeführt. Berlin, 1885. 4to. 5

Almanach de l'Observatoire royal de Bruxelles. Année 52, 1885. Bruxelles, 1885. 374 p. 16mo. 1.50

American Academy.—Memoirs of the American Academy of Arts and Sciences. Centennial volume. (Vol. xi, part 2, No. 1.) Cambridge, 1885. 4to.

——— Proceedings of the American Academy of Arts and Sciences. New series, vol. 12. (Whole series, vol. 20, from May, 1884, to May, 1885.) Boston, 1885. 8vo.

American Association.—Proceedings of the American Association for the Advancement of Science. Philadelphia, 1884. Vol. 33. Salem, 1885. 95+736 p. 8vo.

American Astronomical Society.—Papers. No. 1. Brooklyn, 1885. 32 p. 8vo.

American Ephemeris and Nautical Almanac for the year 1888. 1st ed. Washington, 1885. 519 p.+ 4to.

American Ephemeris.—Astronomical papers, prepared for the use of the American Ephemeris and Nautical Almanac. Vol. ii, parts 3, 4. Washington, 1885. p. 107–258, with 8 plates. 4to. 7.50

Cont.: Newcomb and Michelson, Measures of the velocity of light, made 1880–'82.

——— Astronomical papers, prepared for the use of the American Ephemeris and Nautical Almanac. Vol. iii, parts 2, 3, 4. Washington, 1884. p. 201–371. 4to. 10

Cont.: Hill, Lunar inequalities due to the ellipticity of the earth. Newcomb, On the motion of Hyperion. Hill, Lunar inequalities due to the action of Jupiter.

American Journal of Mathematics. Vol. i–vi. (Vol. i very rare.)

American Philosophical Society.—Early proceedings, from 1744 to 1838. Compiled by one of the secretaries, with full indexes and phototypic illustrations. Philadelphia, 1885. 875 p. 8vo. 25

Analyst (The), including the proceedings of the "Society of Public Analysts." Ed. by G. W. Wigner and J. Muter. Vol. 10 (12 nos.). London, 1885. Roy. 8vo. 6.50

Annalen (Mathematische). In Verbindung m. C. Neumann begründ. d. R. F. A. Clebsch. Hersg. v. F. Klein u. A. Mayer. Band 25 (4 Hefte). Leipzig, 1885. 8vo. 20

——— Same. Band 26 (4 Hefte). Leipzig, 1886. 8vo. 20

Annales du Bureau des Longitudes. Travaux faits à l'Observatoire astronomique de Montsouris (Section navale) et Mémoires divers. Tome iii. Paris, 1885. 6+506 p. 4to. 21

Annales Nouvelles des Mathématiques. Réd. p. Gérono et Brisse. Année 1885. (Série v, tome 4) en 12 nrs. Paris, 1885. 8vo. 15

Annals of mathematics, pure and applied. Edited by O. Stone and W. M. Thornton. University of Virginia. Year 2 (6 nrs.), 1885. 4to. 10

Continuation of the "Analyst," formerly published by J. C. Hendricks.

ANNUAIRE du Bureau des Longitudes pour l'année 1886. Paris [1886?]. 924 p. 4to. Illustr. 1.70

Cont.: Faye, Les 13 Tornados des 29 et 30 Mai, 1879, aux États-Unis.

ANUARIO del Observatorio Astronomico nacional de Tacubaya para el año de 1885. Mexico, 1884. 12mo. 12

ASTRONOMICAL REGISTER.—Vol. 23. Year 1885 (12 nrs.). London, 1885, 7+300 p. 8vo. 12.50

L'ASTRONOMIE. Revue mensuelle d'Astronomie populaire, de Météorologie et de Physique du Globe, publ. p. C. Flammarion. Année 4, 1885 (12 nrs.). Paris, 1885. 488 p. Imp. 8vo. Illustr. 12

ATTI della R. Accademia dei Lincei, 1883–'84. Memorie della Classe di Scienze fisiche, matematiche e naturali. Vol. 17. Roma, 1884. 60+619 p. 4to. 34

Cont.: Dembowski, Misure micrometriche di Stelle Doppie e Multiple, fatte negli anni 1852–'78. Vol. ii.

BÄCKLUND (O.).—Ueber d. Anwendung einer von P. Tschebyschew vorgeschlagenen Interpolationsmethode. (St. Petersb. Acad.) 1885. 30 p. Roy. 8vo. 1

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BAEYER (*Gen.* J. J.), President of the Central Bureau for European Triangulation and of the Royal Prussian Geodetic Institute; b. November 5, 1794; d. September 10, 1885.

VON BOGUSLAWSKI (GEORG); b. December 7, 1827; d. May 4, 1884.

CLAUSEN (TH.), Director emeritus of the Dorpat Observatory; d. May 25, 1885.

FOLAIN (———), Assistant astronomer at the Paris Observatory; b. 1828; d. at Paris, May 26, 1885.

HARTNUP (JOHN), Superintendent of the Liverpool Observatory; b. January 7, 1806; d. October 20, 1885.

HOHWÜ (ANDREAS), Chronometer-maker, Amsterdam; d. September 28, 1885, æt. 82.

SIDEBOTHAM (JOSEPH); b. January 17, 1824; d. May 24, 1885.

WEBB (*Rev.* THOMAS WILLIAM); b. December 14, 1807; d. May 19, 1885.

WRAY (WILLIAM), Optician; b. December 6, 1829, d. ———, 1885.

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Observatoria.
MÜNCHEN (Munich), *Bavaria.*
Königliche Sternwarte, Bogenhausen.
MÜNSTER, *Prussia.*
Sternwarte.
NAPLES (Napoli), *Italy.*
R. Osservatorio, Capo di Monte.
NATAL, *S. Africa.*
Natal Observatory.
NEUCHATEL, *Switzerland.*
Observatoire Cantonale.
NICE, *France.*
Observatoire.
NICOLAEF, *Russia.*
Nicolaevskaia Observatoria.
NOTTINGHAM, *England.*
Private Observatory of Mr. Thomas W. Bush.
ODESSA, *Russia.*
Sternwarte.

OFEN, *Hungary.* (See Budapest, *Hungary.*)
O'GYALLA, *Hungary.*
  Astro-Physikalisches Observatorium.
OLMÜTZ, *Austria.*
  Sternwarte (discontinued).
OXFORD, *England.*
  Radcliffe Observatory.
  Savilian Observatory.
PADOVA (Padua), *Italy.*
  Osservatorio Astronomico dell' Università.
PALERMO, *Italy.*
  R. Osservatorio.
PARAMATTA, *New South Wales, Australia.*
  Observatory (transferred to Sydney, *New South Wales*).
PARIS, *France.*
  Observatoire National.
PARMA, *Italy.*
  R. Osservatorio Astronomico.
PARSONSTOWN, *Ireland.* (See Birr Castle, Ireland.)
PEKIN, *China.*
  Observatory of the Imperial Russian Embassy.
PISA, *Italy.*
  Osservatorio.
PLONSK, *Russia.*
  Observatory of Dr. Jederzejewitz.
POLA, *Austria.*
  Nautisches Observatorium.
PORT LOUIS, *Mauritius.*
  Royal Alfred Observatory.
PORTSMOUTH, *England.*
  Observatory.
POTSDAM, *Prussia.*
  Astro-Physikalisches Observatorium.
PRAG (Prague), *Austria.*
  K. k. Universitäts Sternwarte.
PULKOVO, *Russia.*
  Nicolaevskaia Glavnaia Observatoria.
PUY-LE-DÔME, *France.*
  Observatoire.
QUEBEC, *Canada.*
  Observatory.
QUITO, *Ecuador.*
  Observatorio del Colegio Nacional.
RICHMOND (Surrey), *England.*
  Kew Observatory of the Royal Society.

RIO DE JANEIRO, *Brazil.*
  Imperial Nautical Observatory.
ROME, *Italy.*
  Osservatorio Astronomico del Collegio Romano.
  Osservatorio Capitolino.
RUGBY, *England.*
  Temple Observatory.
RÜNGSDORF (near Bonn), *Prussia.*
  Sternwarte.
SAINT CROIX, *Antilles.*
  Observatoire.
ST. JOHN'S, *New Brunswick.*
  Observatory.
SAIGON, *French Cochin-China.*
  Observatoire.
SAN FERNANDO, *Spain.*
  Instituto y Observatorio de Marina de San Fernando.
SANTIAGO, *Chile.*
  Observatorio Nacional.
SCHWERIN, *Mecklenburg.*
  Geodetisches Observatorium.
SENFTENBERG, *Bohemia.*
  Sternwarte des Baron Perish (ceased to exist).
SLOUGH, *England.*
  Observatory.
SOUTH KILWORTH, *England.*
  Observatory.
SPEYER, *Bavaria.*
  Sternwarte des Königlichen Lyceums (ceased to exist).
ST. HELENA, *St. Helena.*
  Observatory.
ST. PETERSBURG, *Russia.*
  Observatoria Akademii Nauk.
  Zentralnaia Fisitcheskaia Observatoria.
STARFIELD, *England.*
  Observatory.
STOCKHOLM, *Sweden.*
  Observatorium.
STONYHURST COLLEGE (near Whalley), *England.*
  Stonyhurst College Observatory.
STRASSBURG, *Germany.*
  Sternwarte.
SYDNEY, *New South Wales, Australia.*
  Government Observatory.
TACUBAYA, *Mexico.*
  Observatorio Astronómico Nacional Mexicano.

TACHKENT, *Russia.*
Observatoire Astronomique et Physique de Tachkent.
TIFLIS, *Russia.*
Observatoria.
TOKIO, *Japan.*
Observatory of the Daigaku.
TORINO (Turin), *Italy.*
Regio Osservatorio dell' Università.
TOULON, *France.*
Observatoire de la Marine.
TOULOUSE, *France.*
Observatoire de Toulouse.
TREVANDRUM, *India.*
His Highness the Maha Rajah's Observatory.
TRIESTE, *Austria.*
Astronomisches und Meteorologisches Observatorium der k. k. Nautischen und Handels Akademie.
TUNBRIDGE WELLS, *England.* (See Crowborough, England.)
TWICKENHAM, *England.*
Observatory of Mr. Hind.
UPSALA, *Sweden.*
Universitets Observatoriet.
UTRECHT, *Holland.*
Observatorium.
VALENCIA, *Ireland.*
Observatory of the London Meteorological Office.
VARSHAVA (Warsaw), *Russia.*
Astronomicheskaia Observatoria.
VENICE, *Italy.*
Observatory of the Naval Institute.
VERONA, *Italy.*
Osservatorio.
VIENNA, *Austria.* (See Wien, Austria.)
VILNA, *Russia.*
Astronomicheskaia Observatoria.
VIVIERS, *France.*
Observatoire.
WARSAW, *Russia.* (See Varshava, Russia.)
WELLINGTON, *New Zealand.*
Government Observatory.
WHALLEY, *England.* (See Stonyhurst College, England.)
WIEN, *Austria.*
K. K. Universitäts Sternwarte in Währing.
Sternwarte der Technischen Hochschule.
Sternwarte des Herrn Prof. Dr. Th. von Oppolzer.
Observatorium, Hohe Warte.

WILLIAMSTOWN, *Victoria.*
    Observatory (transferred to Melbourne).
WILHELMSHAVEN, *Prussia.*
    Kaiserliche Marine Sternwarte.
WINDSOR, *New South Wales.*
    Observatory of Mr. John Tebbut.
ZIKAWEI, *China.*
    Observatory.
ZÜRICH, *Switzerland.*
    Sternwarte des Schweizerischen Polytechnikums.

VULCANOLOGY AND SEISMOLOGY.

By C. G. ROCKWOOD, JR.,

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In consequence of the early publication of this summary it has been impossible to make it as full as the author had intended, especially with respect to foreign publications. In its preparation the following have been carefully examined, viz: *Science*, vols. V, VI; *Nature*, vols. XXXI, XXXII; *American Journal of Science*, (III,) vols. XXIX, XXX; *Comptes Rendus*, vols. C, CI; *La Nature*, 13th year, vols. I, II; *L'Astronomie*, 4th year; *Neu Jahrbuch für Mineralogie*, etc., 1885; *Transactions Seismological Society of Japan*, vol. VIII; *Proceedings American Association for Advancement of Science*, vol. XXXIII. In respect to these the bibliography may be regarded as complete, and all important articles are noticed in the summary. Other periodicals and books have been consulted as opportunity offered, but without a full examination. The bibliography attached to the present summary also contains some titles which properly should have been included in that of last year, but which had not then come to the author's notice; and in like manner omissions in the present list will be supplied, so far as possible, in a future issue.

The subject-matter will be arranged under the following heads:

Vulcanology.

Volcanic phenomena of 1885.
Volcanic phenomena of previous years.
Causes of volcanic action.

Seismology.

Earthquakes of 1885.
Earthquake lists of 1884.
Earthquake catalogues of previous years.
Study of earthquakes.

Seismometry.

Instruments and their records.

VULCANOLOGY.

The volcanic activity during 1885 continued to be of a very moderate character, as had been the case in 1884, and again the East Indies appears to have been the scene of its most violent development.

In April, 1885, the state of Krakatoa caused some anxiety, as subterranean sounds were heard in the neighborhood day after day, but no outbreak occurred. (*Nature*, XXXII: 161.)

On April 17 and 18 a violent eruption of Smeru, the largest and most active volcano in Java, occurred, by which the side of the mountain for one-third of the way down was described as burst open and emitting lava and mud. (*Nature*, XXXII: 101.)

Several other Javanese volcanoes also manifested signs of activity, which was again further reported as recurring in June and July, especially by another eruption of Smeru on July 8 and 9. Accounts of these eruptions are meager and vague, but they apparently involved the destruction of many coffee plantations, and some loss of life. (*Nature*, XXXII: 401; *La Nature*, II: 102.)

On May 2, 1885, lava began to flow from a rent in the side of the cone of eruption of Vesuvius, and continued for some days. According to Johnston Lavis, who visited the spot, this outburst of lava did not indicate any great increase of volcanic activity, but was simply the breaking through the cone of a dike which had been in process of slow formation during several years, being thus a repetition of what happened in December, 1881. (*Nature*, XXXII: 55, 108.) The lava came near the station of the mountain railway, but did not damage the road, although its use was interrupted for a time. (*La Nature*, I: 398.)

On the morning of July 23, 1885, an eruption of Cotopaxi occurred, with considerable emission of lava, which caused some damage and loss of life, but it is not yet known how great. (*Nature*, XXXII: 375, 428.)

Grewingk, the volcano at Bogosloff Island, was seen by Lieutenant Stoney's exploring party in the summer of 1885. It was emitting less smoke than in the previous year, but no other important change was noticed. (*Science*, VI: 279.)

Advices from Alaska in the summer also report the volcano of Chernabura, or St. Augustin, in Cook's Inlet, as still pouring out smoke and steam from innumerable fissures. (*Science*, VI: 95.)

The New Zealand Herald, of November 3, 1885, contained an account of a new volcano which has appeared in the Pacific Ocean. It burst forth on October 12 or 13, 1885, about fourteen or fifteen miles north-northwest of the island of Honga Tonga in the Friendly Group. It was visited on October 14 by a party from Tonga, and was found to have formed an island two or three miles long and some sixty feet high. As it was in continuous eruption, of course a close examination was impossible. The position of this new volcano is in latitude 20° 21′ south, longitude 175° 28′ west. (*Science*, VII: 69.)

The first part of Verbeek's Report on the Krakatoa eruption, issued by the Dutch East Indian Government (Batavia, 1884), dealt with the prior history of the island and the events of the catastrophe itself, leaving to the second part the scientific results of the investigation. The editor examined 1,300 reports of eye-witnesses, and has endeavored from them to construct a chronological statement of the events preceding and accompanying the eruption. (*Nature*, XXXI: 279.) The second part has now been completed, and has fully realized the expectations raised by the publication of the first part. It contains twenty-five colored drawings and forty-three maps, and reflects the greatest credit not only on the author, but on the Dutch Indian Government which sent him to study the causes and effects of this catastrophe, and which so efficiently aided him in the work. A few of his conclusions may be mentioned here. Krakatoa lies at the intersection of three fissures in the earth's crust, and the earthquake of September 1, 1880, which damaged the light-house on Java's First Point, probably affected the Sunda fissure and facilitated the entrance of greater quantities of water to the volcanic furnace beneath. Here may be found the remote cause of the outburst of 1883. The geology of Krakatoa is presented by two maps and four sections showing different stages of its development, the formation of the peak Rakata by a lateral eruption, the addition of the two parasitic cones of Danan and Perbvewatan, and finally their destruction by the explosion of 1883. The first three stages antedate any authentic records. In the last stage Perbvewatan became active in May, 1883, Danan joined it in June, and in August both these with half of Rakata were destroyed and are now covered by the sea. Portions of the pumice from the eruption were carried westward to the coast of Africa. Another portion, after floating for months in the straits, was, in 1884, driven eastward, and in 1885 was encountered in the Pacific Ocean near the Caroline Islands. (*Nature*, XXXI: 288.) The author expected that this might reach the west coast of America early in 1886. The distance to which the explosions were heard is illustrated by a map, and the curious fact that certain detonations were heard at distant places and not noticed at nearer ones is attributed to the presence of a dense ash cloud surrounding the peak and checking the transmission of sound through the lower atmosphere. About seventy pages are devoted to a discussion of the atmospheric wave which made the circuit of the globe. With the aid of accurate barograms from Sydney, N. S. W., and from Batavia he was able to calculate the hour of the greatest explosion and origin of the wave as 10 hours 2 minutes a. m., Krakatoa time. Forty places are named where the passage of the air-wave was recorded by barometers. Treating of changes in the sea bottom, he says the northern part of Krakatoa is now covered by the sea to a depth of 200 to 300 meters, and within the ring of islands which are fragments of the old crater-ring an area of 41 square kilometers has subsided. Outside these islands also the sea is deeper than formerly over an area of 34 square kilometers, so that in all there has been a subsidence of about 75 square kilometers. There has been no elevation of the sea bottom other than that caused by the fallen materials ejected from the volcano. After a discussion of the great sea-waves which caused so much devastation, and the greatest of which started at 10 hours 2 minutes a. m., the time of the greatest explosion, a chapter is devoted to other volcanic phenomena taking place during the Krakatoa eruption, within or beyond the Indian Archipelago, even to the antipodes, especially other volcanoes in Sumatra and Java and earthquakes in Australia. In conclusion the author maintains the doctrine that part of our globe is still in a molten state, and disputes the theory that the heat of the volcano is entirely due to chemical action. (*Nature*, XXXII: 601.) A review of Verbeek's work by E. Metzger, is published in Petermann's *Mittheilungen*, 1886, Hft. I.

In a series of articles in *La Nature* M. Breon gives a very interesting account of the visit made by M. Corthals and himself to the Strait of Sunda and Krakatoa in May, 1884, being sent out by the French minister of public instruction. The apparent division of the small island Dwars-in-den-Weg into four fragments was found to consist simply in the denudation of the low parts of the island of their verdure by the great sea-wave, while the higher portions escaped. At the head of Lampong Bay they found Telok Betong entirely destroyed, and the place where it stood now occupied by a marsh. Passing up the course of the small river which empties into this bay, they found the steamer Barrow stranded across the stream and surrounded by a luxuriant growth of tropical vegetation. The island of Sebesie was covered with ashes to a depth of ten meters, and every one of its 2,000 inhabitants perished. In one place the visitors came upon the remains of a village where were found the skeletons of fifty victims of the catastrophe. The ephemeral islands of Steers and Calmeyer had already disappeared beneath the waves, having endured less than a year. Coming to Krakatoa its condition is described. The frequent fall of stones down its sides, simulating renewed volcanic activity, was attributed to the influence of solar heat causing unequal expansion. The phenomenon was at its maximum when the mountain was exposed to the direct rays of the sun, and almost ceased during the night. They landed upon Krakatoa, and also upon Verlaten and Lang islands, and although nine months had elapsed, the recent deposits still exhibited an elevated temperature in places. The account of their visit closes with a résume of the geological characteristics of Krakatoa. It is illustrated by a number of views reproduced from photographs. A condensed account of the above is reproduced in *Science* (VI: 291).

Professor Forel admits as not impossible that the Krakatoa explosion was the origin of certain subterranean noises heard on August 28, 1883, at the island of Caiman Brac, in the Lesser Antilles, situated near the antipodes of Krakatoa. Observers compared the noise to that of a distant cannonade. It agreed tolerably well in time with the Krakatoa explosion, and there was no other volcanic eruption to which it could be attributed, its connection with the known eruptions of Ometepec or of Cotopaxi or with some otherwise unnoticed submarine eruption being considered and rejected. (*Nature*, XXXI: 483; *La Nature*, I: 362.)

Mr. Henry Cecil suggests that if the synchronism of these noises at Caiman Brac and Krakatoa is admitted it does not follow that the noise was propagated from Krakatoa through the globe. Both may have originated from a disturbance taking place deep within the earth. (*Nature* XXXI: 506.) Similar subterranean detonations were reported as heard on August 27 and 28 in San Domingo, in San Salvador, and at Antioquia, in Colombia. (*Compt. Rend.*, C: 1314, 1315.)

Dr. Fr. Schneider, of Soerabaya, has discussed (*Jahrb. K. K. Geol. Reichsanst. Wien*, 1885) the volcanic condition of the Sunda Islands and the Moluccas, and thinks that the importance of the Krakatoa eruption has been greatly overestimated. Whether in the extent of its earthquake circle, the amount of ashes thrown out, or the distance to which the ashes were thrown, it has been much surpassed by other volcanoes of Java, notably by the eruption of Temboro in 1815. After discussing the probable mode of formation of Java by the junction of three islands once separate, he describes in some detail the position and relations of the principal Javan volcanoes, especially in relation to the earthquakes recorded in their several districts.

Prof. J. Kiessling, of Hamburg, and F. A. Forel have both published valuable papers on the reddish corona about the sun. Both writers conclude that there is no question of the connection of the ring with the famous sunset glows and of the origin of both of these phenomena in the dust cloud thrown out from Krakatoa. (*Science*, VI: 159.)

J. Denza and also A. Boillot, commenting before the Paris Academy on the reappearance of the sunglows in the summer of 1885, think they are *not* due to Krakatoa dust but to vapor of water. (*Compt. Rend.*, CI: 1032.)

In *Nature* there is figured and described some of the apparatus by means of which Professor Kiessling produced artificially effects similar to the cloud glows. It consists essentially of a glass globe through which a beam of light from a heliostat may be passed and within which the desired condition of suspended dust or vapor may be produced. (*Nature*, XXXI: 439.)

C. E. Dutton describes, from personal observation, the appearance presented in the summer of 1885, by Feather Lake, Plumas County, California. This was thought to have been the scene of the most recent volcanic eruption within the limits of the United States, stated by J. B. Trask to have occurred in 1850. The lava emitted forms a field about three and a quarter miles long by one mile wide, with an average thickness of over 100 feet. The cone of scoriæ and lapilli covering the vent is 600 feet high and of extremely perfect form, showing as yet no rain channels even. For a space of four or five hundred yards from it the trees were all killed and their fallen and partly decayed trunks are still lying on the ground. All appearances confirm the date assigned by Trask, although at that time it was not probably seen by any persons but the Indians. (*Science*, VI: 46.)

George Davidson adds to this accounts of smoke seen from a distance to issue from Mount Baker in 1854, 1858, and 1870, and seeming to indicate eruptions of that mountain, but the locality has not been visited and no details of them are known. It is not impossible that still other evidences of recent volcanic activity may be found in those sections of our country as they come to be more fully explored. (*Science*, VI: 262.)

In the narrative (vol. i) of the Challenger Expedition the volcano of Camiguin Island, which burst forth in 1871, is described and a plate given, which is reproduced in *Nature*, XXXII: 250.

An English Parliamentary blue book (Corea, No. 3, 1885) contains a description by Mr. Carles, the vice-consul at Seoul, of a vast lava field in Corea, which is said to exceed even those in Iceland. (*Nature*, XXXII: 403.)

In a memoir of 137 pages printed in the Fourth Annual Report of the United States Geological Survey, Captain Dutton gives a detailed account of his visit to and examination of the volcanoes of the Sandwich Islands in 1882, and applies the results to a discussion of the volcanic problem. He examines the various theories suggested by different writers to account for the production of volcanoes, and considers what new light is thrown upon each by his observations, but does not pronounce decidedly in favor of any one of the theories stated.

At a meeting of the British Royal Society (April 16, 1885), Prof. Joseph Prestwich presented an interesting paper "On the agency of water in Volcanic Eruptions" and other related topics. Admitting as an established fact that the vapor of water plays an important part in many volcanic eruptions, it still remains an open question whether its agency is to be regarded as primary or secondary, and how it may have reached that part of the earth's crust where its force must be exerted to produce an eruption. The author reviews the opinions of Daubeny Mallet and Poulett Scrope, especially of the latter as the explanation most generally accepted by geologists. This holds that the outflow of lava is caused by the expansion of volumes of steam generated in the molten mass beneath the eruptive orifice. The author questions the possibility of water penetrating the solid crust of the earth to a sufficient depth to reach a molten magma within, finding a main difficulty in thermo-dynamic considerations connected with the excessive pressure which must result at comparatively moderate depths and temperatures. But the most weighty objection to the theory is found in the absence of any distinct relation between the discharge of lava and that of vapor. There are numerous instances in the history of Etna, of Santorin, and especially of Mauna Loa where vast discharges of lava have occurred, not only without steam explosions, but with almost the quiet of a water spring.

On the other hand, paroxysmal eruptions often begin with a violent burst, followed by a series of explosions, with but little extrusion of lava, and sometimes with absolutely none at all, only scoriæ being emitted, as at Cosaguina and Krakatoa. The author would account for the presence of great quantities of water in some eruptions by the admission of the surface waters, or sometimes of sea water, to the volcanic duct during the eruption itself, and gives diagrams of the altered water levels about a volcano during an eruption to show the possibility of such admissions. Concluding, then, that water plays only a secondary part in originating volcanic phenomena, he is inclined to recur to the old hypothesis of a comparatively thin, flexible earth-crust resting upon a molten substratum; but instead of adopting anew the theory of a fluid interior to the earth, which physical reasoning has shown to be untenable, he thinks the phenomena are best accounted for by the supposition of a thin crust, resting on a viscid layer also of no great thickness, and wrapping round a solid nucleus. He concludes that the viscid magma thus compressed between two solid layers by the secular contraction of the globe is extruded where it may find or make an opening. And while the extravasation of lava is due to these causes, the presence of vapor is due only to the surface and underground waters with which the lava comes in contact as it rises through the volcanic duct. (*Nature*, XXXI: 592.)

Similar opinions as to the part played by water in volcanic outbursts, and the source from which the water is derived, were expressed before the Geological Society by H. J. Johnston-Lavis. (*Nature*, XXXII: 69.)

The discussion of the theoretical form of volcanic cones, begun by Professor Milne in 1878 and 1879 (*Geol. Mag.*), is renewed and carried on by George F. Becker. (*Am. Jour. Sci.*, XXX: 283.) Milne had regarded the problem as being that of the form assumed by loose materials, cinders, ashes, etc., and concludes that it would be that generated by the revolution of a logarithmic curve round its asymptote. But Becker regards the mountain as essentially a continuous mass, and deduces the equation of the curve, which by its revolution will generate the finite unloaded column of "least variable resistance," for which he finds $\frac{y}{c} = \frac{\varepsilon^{-\frac{x}{c}} - \varepsilon^{\frac{x}{c}}}{2}$. This is a special case of the equation $w = A\,\varepsilon^{-\frac{x}{c}} + B\,\varepsilon^{\frac{x}{c}}$ which he has elsewhere shown to characterize the arrangement of sheets of rock in a complex fault, and which belongs also to several other physical phenomena. On comparing graphically this theoretical curve with actual outlines drawn from photographs of volcanic cones, as with Fusiyama and Kumagatake in Japan, and Hood and Popocatapetl in America, the similarity of the several outlines is at once evident.

Velain's book "Les Volcans" is briefly reviewed by Captain Dutton, stating the contents of the several chapters, with comments thereon. (*Science*, vi: 255.)

On February 16, 1885, the French Academy of Sciences appointed a committee to consider communications regarding volcanic and seismic phenomena. The members of this committee are MM. Daubrée, Jamin, Hébert, Fouqué, and A. Gaudry. (*Compt. Rend.*, C: 438.)

SEISMOLOGY.

The earthquake of January 2, 1885, in Maryland and West Virginia was studied by Professor Rockwood, and the results were published in *Science* (V: 129), with a map of the area affected. It was most severe in the southern part of Frederick County, Maryland, and affected an area of about 2,500 square miles, whose center was somewhat south of Leesburg, Va.

On May 13, 1885, and following days, a destructive earthquake occurred in Cashmere, and the series of shocks was renewed at intervals for at least a month thereafter. Many villages were destroyed, with the formation of crevasses and landslides, and the loss of life reached 3,081 persons, besides 25,000 sheep and goats and 8,000 cattle. The number of dwellings destroyed was estimated at 75,000. The Indian Government sent a geological surveyor to report on the scientific aspects of this catastrophe. (*Nature*, XXXII: 207.)

The earthquake which has attracted the most attention during the past year occurred in the provinces of Granada and Malaga in Southern Spain. It was made the subject of special investigation by commissions appointed by the Spanish Government and by the French Academy of Sciences. The first and most violent shock occurred on the evening of December 25, 1884, but the shocks were repeated at frequent intervals through the remaining days of December, and through January, 1885, and even in March and April they were still felt occasionally. The connection of this earthquake with the disturbed geological character of the Peninsula was discussed in various places by J. Macpherson, A. F. Noguès, and others, and most interesting results were reached, but they cannot be stated with sufficient brevity for insertion here. (See *Comptes Rendus*, *La Nature*, *Nature*, *&c.*)

The commission appointed by the Spanish Government, as above mentioned, made a preliminary report of their labors and conclusions up to March 7, 1885. (*Bibliography*, No. 21.) It forms a pamphlet of 107 pages octavo, accompanied by two reproductions of photographs of the destruction caused by the shock. It deals quite fully with the matter in hand, and states conclusions which, though often only negative, are yet of interest. Beginning with a statement of the theories proposed by various writers to account for earthquakes, it proceeds to give a description of the orography and hydrography of the two provinces of Granada and Malaga, and then devotes twenty-one pages to the geology of the same district, describing in detail the rock formation, with the location and direction of its principal fault-lines. The area affected by the earthquake is described as bounded toward the north by Madrid and Segovia, toward the west by Cáceres and Huelva, toward the east by Valencia and Murcia, and on the south by the Mediterranean; but the tremor of the earth was also indicated by instruments even so far distant as Rome and Brussels and Wilhelmshaven. (*Nature*, XXXI: 491.) Examination of the direction of the cracks in the ground and in buildings, as well as of the curves of intensity estimated according to the Rossi-Forel scale, leads to the conclusion that the focus is to be found in the valley of Zaffaraya, where the greatest damage was caused. The latter half of the report is occupied with the physical, magnetic, barometric, and other phenomena attending the earthquake. The number of buildings injured in the two provinces is stated at 17,178, of which 4,399 are classed as totally destroyed. The injured persons numbered 745 dead, and 1,485 wounded. In discussing the cause of this earthquake the commission accepts the Italian theories, attributing earthquakes to the tension of the vapor of water in the subjacent strata. The valley of Zaffaraya, indicated above as the probable focus, is a locality where much water gathers and easily penetrates beneath the surface, and to the vapor of high tension produced from the water here collected in deep lying strata are attributed the forces which gave rise to the present earthquake. The commission consisted of M. F. de Castro, J. P. Lasala, Daniel de Cortázar, and J. Gonzalo y Tarin.

On March 2, M. Fouqué gave to the French Academy a preliminary report on the exploration which the committee under his charge had made of the phenomena of the Spanish earthquakes. The committee consisted of MM. Fouqué, Lévy, Bertrand, Barrois, Offret, Kilian, and Bergeron, and was accompanied by M. Breon. This first communication speaks only of their journey, the facilities afforded by the Spanish authorities, and certain phenomena observed, reserving the discussion of theoretical questions to another time. (*Compt. Rend.*, C: 598.)

The full reports of the French committee may be found in *Comptes Rendus* Tome C, and besides a general consideration of the phenomena and their cause, they include two special reports on the geology of the district by members detailed for that purpose. In the general conclusions reached they agree with the Spanish commission, and fix the centrum in an elliptical area surrounding Zaffaraya; but in regard to the cause of the disturbance M. Fouqué rejects the theory which attributes it to the local tension of water vapor, and would refer it rather to the general volcanic forces within the globe.

The *Meteorologische Zeitschrift* for February, 1885, contained a notice by Dr. Eschenhagen on the effect which was apparently produced by the Andalusian earthquakes on the magnetic apparatus at Wilhelmshaven. The effect seems to have been not at all of a magnetic character, but purely mechanical, the delicately suspended magnets acting as the pendulum of a seismoscope. Attempts to draw from the observed times some inference as to the rate of propagation of the disturbance were deprived of value by the uncertainty of time at the origin in Andalusia. (*Nature*, XXXI: 491.)

C. W. C. Fuchs, in his twentieth annual report (*Min. u. Petrog. Mittheil.*, 1885) notes the dearth of volcanic phenomena in 1884, there being nothing worthy of mention except the slight activity of Vesuvius and Etna, and of St. Augustin in Alaska, which are all disposed of in a single page, and then describes the earthquakes of the year. His report mentions 123 shocks, distributed in time as follows: winter, 57 (December, 19; January, 28; February, 10); spring, 24 (March 13; April, 7; May, 4); summer, 21 (June, 5; July, 9; August, 7); autumn, 21 (September, 8; October, 1; November, 12). On fourteen days two or more places were affected, and twelve localities were shaken on two or more dates. This report mentions only four American earthquakes (March 25, August 10, September 18, 20), Professor Rockwood's report for the year not having been received by Dr. Fuchs before this was printed. Those earthquakes deserving individual mention are: March 24, 1884, in Upper and Central Slavonia, where, in Diakovar and other places, numerous buildings suffered injury; April 22, in England; May 13, in Crevassa, where a church and other buildings were destroyed; May 19, on the Persian Gulf, in which 200 persons fell victims by the overthrow of their houses; August 10, in the Eastern United States; and the Spanish earthquakes in December. In regard to the earthquakes in Spain, Dr. Fuchs discusses at some length their relation to the geological structure of the Peninsula, concluding that the centrum was not a point, but a line parallel to the Sierras Tejeda and Almijara. He differs from those writers who call these earthquakes the most important in Europe, thinking that of the earthquakes which have occurred during the last ten years, those of Belluno, 1873, of Agram, 1880, and of Chios, 1881, are of equal importance. An appendix mentions Verbeek's book on Krakatoa, and adds to his own previous reports 170 earthquake dates, 80 for 1882, 90 for 1883. These, however, do not indicate so many hitherto unreported earthquakes, as many of them refer to continuous *series* of light shakings, and others give additional details regarding earthquakes already mentioned in his reports for those years.

In his Fourteenth Notes on American Earthquakes (*Am. Jour. Sci.*, XXIX: 425), Professor Rockwood has collected the records of earthquakes for 1884. The list contains 54 items, classified geographically as follows: Canadian Provinces, 5; New England, 9; Atlantic States, 5; Mississippi Valley, 7; Pacific Coast, 21; West Indies, 2; Central America and Colombia, 3; Peru, 2; Uruguay, 1. By seasons they were: winter, 12 (December, 2; January, 8; February, 2); spring, 15 (March, 8; April, 7; May, 0); summer, 8 (June, 4; July, 0; August, 4); autumn, 19 (September, 4; October, 5; November, 10); spring and summer together, 23; autumn and winter together, 31. Most of the shocks were light. The only ones of destructive importance were: November 5 and 6, on the Isthmus of Panama and in Colombia, when the damages were estimated from

$250,000 to $400,000, and the church of San Pedro at Cali was wrecked; November 22, at Lima, Peru, where many houses were injured, and August 10, in the Eastern and Middle States, when walls were cracked and chimneys overthrown. Two earthquakes of the year were made the subject of special study, and maps of the regions affected are given, showing the isoseismals, so far as material for drawing them was at hand. In the earthquake of August 10 the area of greater intensity is nearly elliptical, extending from Hartford, Conn., to West Chester, Pa., and the conclusion reached is that this earthquake was due to some rupture of the strata underlying the immediate vicinity of New York City. On September 19 an earthquake occurred in Ohio and Indiana, affecting an approximately circular area with a diameter of about 400 miles. The isoseismals are much more regular in this earthquake than in that of August 10, and its cause is referred to the geological anticlinal known as the Cincinnati arch, which crosses the western part of Ohio from south to north.

M. C. Detaille has also published (*L'Astronomie*, 1885, p. 183) a list of earthquakes felt in 1884. It gives 165 dates, and is especially rich for South American regions, including very careful reports from Valparaiso. It gives reports of 32 shocks at Valparaiso, none of which are contained in Rockwood's nor in Fuchs' lists. In regard to the earthquakes of North America it is much less complete and often inaccurate.

The catalogue of earthquakes recorded by the Palmieri seismograph at the Imperial Meteorological Observatory in Tokio is contained in vol. VIII of the Transactions of the Seismological Society of Japan. It includes 109 shocks (Nos. 498–606) on dates between July 28, 1883, and April 25, 1885. For most of them the force and direction is given in Palmieri's scale, with the duration, but without other information.

The following was compiled from the records of the Meteorological Observatory in Tokio. It gives the total number of earthquakes recorded in the several months during the ten years ending December 10, 1884, as follows: January, 53; February, 50; March, 73; April, 43; May, 51; June, 40; July, 36; August, 27; September, 15; October, 47; November, 51; December, 60. The average per month for the ten years is 45; that for the six winter months (October to March) is 56, and that for the six summer months is 35, or about 40 per cent. less, which gives some support to the notion that earthquakes are more frequent in winter than in summer. (*Nature*, XXXI: 322.)

The system of seismic observation established in Italy under the direction of M. E. de Rossi includes twenty-eight stations already in operation and reporting to the Central Geodynamic Observatory at Rome. All are provided with delicate instruments, and study not only the sensible earthquakes, but also, and more particularly, those minute movements of the ground which are only recorded by the seismograph. These movements are already distinguished into two classes: (1) those characterized by a very rapid vibration; (2) those exhibiting a very slow wave-like motion. (*Compt. Rend.*, C: 758.) The work of this observatory is also described in *La Nature* (I: 363), and illustrated by specimens of the daily maps issued by the observatory. The maps given are those illustrating the phenomena of the earthquake which occurred near Modena on February 26, 1885.

The work of the Swiss Seismological Commission, from its appointment in 1879, is summarized by W. M. Davis in *Science* (V: 196). Among other things there will be found here the statement of the scale of intensity adopted by the Italian and Swiss observers, and commonly known as the Rossi-Forel scale. In forming a number to represent the "value" of an earthquake, it is necessary to combine with the intensity-scale number others to represent the area affected and the number of accessory shocks. For Switzerland the areas are grouped by diameters of 5, 50, 100, and 150 kilometers, and the weak, medium, and strong shocks are reckoned separately (n, n', n''); then the adopted value is $V =$ (intensity scale × area scale) $+ n + 2n' + 3n''$. Professor Davis thinks this formula would be improved by squaring the intensity number to offset the much greater intervals between the upper numbers of that scale. (*Science*, V: 197.)

The third report of the Swiss Seismological Commission, by Forel, covers the years 1882 and 1883. It gives a detailed list of the earthquakes observed during the two years, with the accessory shocks. The intensity of each earthquake is marked according to the Rossi-Forel scale, and its "value" computed by the formula mentioned above. These numbers are tabulated and compared with the mean of the two years 1880 and 1881, and with the separate numbers for those years. From the results the author infers that there was a maximum of seismic activity in Switzerland in 1881, which a comparison of the monthly values shows to have been in November of that year, and that in 1882 and 1883 the activity was notably diminished. This was especially so in the latter year, in which no earthquake "value" reached even the *average* value for 1881, and the mean "value" for 1883 scarcely exceeded *one-third* of the mean value for 1881. (*Arch. des Sci., Phys., et Nat.*, XIII: 377.)

M. Montessus, in transmitting to the French Academy his work on Central American Earthquakes, published in San Salvador, states that he entered upon the work and collected a large amount of material with the purpose of formulating, if possible, the rules by which the inhabitants, apparently from meteorological considerations, announce in advance the occurrence of an earthquake. He was, however, soon convinced that the connection between earthquakes and meteorological phenomena, if any, is not yet sufficiently understood to base predictions upon it, although a hope is expressed that the further study of material collected may give some results. (*Compt. Rend.*, C: 1312.)

Commenting upon the not infrequent observation that earthquake shocks are felt more severely at the surface of the earth than in mines,

J. Le Conte suggests that a reason for it may be found in a principle of wave motion published by Airy in 1849. A normal sea wave striking against a wall will be reflected, but if a "broken-headed" wave or breaker strike such a wall the normal part only will be reflected, while the broken part, if it strikes perpendicularly, will be destroyed, or if it strike at a small angle, will then run along as a strong wave clinging to the surface of the wall. He regards the surface of the earth as a reflector for earthquake waves, and notes that the waves themselves are pre-eminently broken waves, and hence ought to follow the above law. (*Science*, VI: 540.)

A fourteen-page note on the East Anglian earthquake of April 22, 1884, with two maps, occupied nearly the whole of Symon's Meteorological Magazine for May, 1884. A full report on the same earthquake by R. Meldola and William White, illustrated by numerous photographs, was read before the Essex Field Club in March 1885 (*Nature*, XXXI: 395). It forms a book of 225 pages and deals very fully with the circumstances of the earthquake. It is divided into eight sections, of which the first is historical, giving a catalogue of sixty previous British earthquakes from A. D. 103 to 1881; the second describes the method of securing information, and the third and fourth are devoted to the phenomena of the shock. In summarizing this portion it is stated that "the main axis of disturbance extends on each side of a line about five miles in length, having a direction northeast and southwest from Wivenhoe to Pelton." In other portions of the report the geological relations are considered, the effect of the shock on the underground waters, and the correspondence in direction of the seismic axis with fault-lines and with the coast-line of Essex. In speculating on the cause of the earthquake the authors only venture to suggest "a sudden rupture of deep-seated rocks under a state of strain"; and add—"the precise formation in which this rupture occurred cannot even be conjectured." (*Nature*, XXXIII: 265.)

Dr. H. J. Johnston-Lavis announced the approaching publication, by subscription, of a "Monograph of the Earthquakes of Ischia," a memoir dealing with the seismic disturbances in that island within historic times, with special observations on those of 1881 and 1884. (*Nature*, XXXI: 563.)

Before the Seismological Society of Japan, Professor Koto read a paper on "Movements of the Earth's Crust," observed in Japan, concluding that the south and east coasts are gradually rising, while the north and west coasts are subsiding. This phenomenon is no doubt connected with the greater seismic activity along the eastern seaboard, shown by the fact that almost all of the earthquakes felt at Tokio come from the east and southeast. At the same meeting, K. Sekiya, who is in charge of the Seismological Observatory of the University of Tokio, described in detail the earthquake of October 15, 1884, which affected an area of 24,728 square miles, and noted its similarity to that of February 22, 1880, both originating on the east side of the

Bay of Yedo, and both affecting the same area. (*Nature*, XXXI: 515.) Commenting upon this same earthquake, Prof. J. A. Ewing, of Dundee, notes that the instrumental record shows an actual motion of the ground of 4.3 centimeters, an amount which is in most striking contrast with the 5 to 7 millimeters that previous experience in Japan had led him to regard as the extreme amount of displacement in ordinary Yedo earthquakes. (*Nature*, XXXI: 581.)

Early in 1885 Professor Ewing received a grant of £100 from the Government grant committee with which to institute observations of earth movements at Ben Nevis. He proposes to set up apparatus with which to look for earth tremors, and also for slow changes of level of the ground. (*Nature*, XXXI: 298.)

The French Academy of Sciences has proposed as the subject for the Vaillant prize the following: "To study the influence which may be exerted on earthquakes by the geological state of a country, by the action of water or of other physical causes." The memoirs competing for this prize are to be delivered before June 1, 1886. (*Compt. Rend.*, CI: 1413.)

A second conference of persons interested in seismology was called by the Director of the United States Geological Survey, and met in Washington on November 25, 1885. The conference was presided over by Captain Dutton, of the Geological Survey, and included Mr. Hayden, of the Survey, Professors Paul, of the Naval Observatory, Mendenhall and Marvin, of the Signal Service, Davis, of Cambridge, and Rockwood, of Princeton. It was agreed that the most important advance in the study of seismic phenomena was to be reached through a distribution of seismoscopes, with sufficiently accurate clocks, over certain areas in the United States which have been shown to be most subject to such disturbances. At the same time the organization of a large corps of non-instrumental observers was thought desirable. The work of bibliography was reported to be in a good state of progress, and several seismoscopic instruments were exhibited. (*Science*, VI: 491.)

SEISMOMETRY.

In a long paper printed in the eighth volume of the Transactions of the Seismological Society of Japan, Professor Milne has gathered a detailed description of ten series of experiments carried on at different times from 1881 to 1884, for the purpose of investigating phenomena connected with earth vibrations. The experiments were all performed in or near the city of Tokio, and consisted in originating artificial earth vibrations, usually by dropping a heavy weight or exploding dynamite, and then studying the circumstances of their propagation by means of the various seismographs devised by himself or Professor Ewing or Professor Gray. Some of these experiments have been already described elsewhere by the author (*Lond. Phil. Mag.*). The paper is closed by a statement in six pages of fifty-seven general results, among which are these: The first effect upon a seismograph with a single index is an impulse in a normal direction, and similarly a bracket seismograph arranged to indicate normal motion begins its indications before a similar instrument indicating transverse motion, implying that the normal wave travels more rapidly than the transverse. Near to the origin the normal motion is first outwards, then inwards, and the motion inwards is greater and more rapid than the motion outwards; while at a distance from the origin the first motion may be inwards, and the two phases are practically of equal amplitude. Roughly speaking, the amplitude of normal motion is inversely as the distance from the origin. The laws of transverse motion are practically the same as those of normal motion, but less pronounced. Near to the origin the amplitude of the transverse motion is less, but the period greater than that of the normal motion. The velocity of transmission varies from 200 to 600 feet, which is much less than the velocities obtained by Mallet and Abbot.

On October 10, 1885, Flood Rock in Hell Gate was blown up by dynamite. The preparations for this event had been going on for ten years, and involved the excavation of galleries beneath the rock and the storing therein of nearly 300,000 pounds of explosives. It was expected that such an explosion would cause vibrations of the earth similar to an earthquake, and as the day for its occurrence approached preparations for studying the propagation of this vibration were made both by the officers of the Engineers, under whose direction the work was done, and by volunteers from the Seismological Conference in Washington, who went to New York for the purpose, and established their instruments at such points in the neighborhood as were found available. Directors of astronomical observatories near New York were also requested by them to co-operate by watching for the arrival of the earth wave. (*Science*, VI: 315.) Unfortunately the firing of the mine was slightly delayed, and did not take place until about fourteen minutes after the hour announced. This delay interfered seriously with the observations of the volunteer observers, a considerable number of whom gave up the watch before the explosion occurred, either supposing that the vibration had failed to reach them or being deceived by some local tremor. It was, however, caught at Princeton, N. J., and at Harvard College. The observations obtained by the volunteers were quite discordant, but indicate a much higher velocity than was obtained by Mallet, or by General Abbot from the Hallett's Point explosion in 1876. General Abbot had arranged a series of observers to Patchogue, L. I., in one direction, and to West Point in another, who were in telegraphic communication with the firing point at Astoria. (*Science*, VI: 431.) His results, although also discordant, give velocities much higher than those deduced from natural earthquakes. (*Science*, VII: 25.)

An instrument for the automatic registration of earth-tremors and earth-tips is described by John Milne (*Nature*, XXXII: 259). Its essential parts are a pendulum one meter long, suspended from a tripod about 5 feet high, and acting upon the short upper arm of a light balanced lever, whose long arm touches a strip of paper covered with a film of iodized starch. This paper is carried by clock-work beneath the point, and every five minutes the clock sends a galvanic current through the pointer and leaves a dot upon the starch film. On examining the records thus made he finds (1) sometimes for days the pointers are stationary; (2) sometimes they are in a state of tremor, which may continue for ten or twelve hours, and the sparks mark the paper at many points in a band several millimeters wide; (3) sometimes the pointer will slowly wander from the straight line and then return, but the author is not yet certain whether this last is due to a slow earth-tip or to local causes. The delicate instrumental observations proposed to be made in the Takashima mine were found impracticable, and it was then proposed to remove the instruments elsewhere.

K. Sekiya has described a form of Ewing's duplex pendulum seismometer, which it is stated can be made at a cost of only about $6, and which gives indications agreeing very well with those obtained from the more elaborate instrument. (*Trans. Seis. Soc. of Japan*, VIII: 83.)

Dr. F. Du Bois has translated from a paper received from F. Faura, of Manila, a description of the Cecchi seismograph constructed for the observatory there. The apparatus is attached to the perpendicular face of a marble slab, and consists of a clock, a vertical pendulum, several weights suspended by springs, and a moving sheet of smoked paper. The whole is so arranged by a combination of levers and strings that any motion, either horizontal or vertical, will start the clock and will put in motion the smoked paper, on which the vertical pendulum records its vibrations, as does also a spring-suspended weight. The arrangement is complicated, needs a number of delicate adjustments, must necessarily be expensive, and finally must be entirely reset throughout after every shock. (*Trans. Seis. Soc. of Japan*, VIII: 90.)

A novel seismograph is described by M. Cordenons in *La Nature* I: 237. It is intended to record the vertical and horizontal shocks, their duration, and the time of the initial shock. It consists of two horizontal pendulums to mark vertical motions, and four inverted pendulums, each of which last is free to fall only in one direction, the four motions being directed along the four sides of a square, so that only that one will fall which is in the direction of the earth's motion. The fall of any one of the pendulums suffices by a system of cords to release a clock pendulum previously fastened out of the perpendicular, and so to start the clock. When once the arrival of an earthquake shock has been signaled by the motion of some pendulum, no further record is possible until the instrument is reset. It is therefore a seismoscope rather than a seismograph.

W. Werner has given to German readers a good account of the recent appliances for the instrumental observation of earthquakes, the material for which is mostly drawn from Ewing's memoir on Earthquake Measurement. (*Zeitschr. für Instrumentenkunde*, V: 217, 308.)

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VOLCANIC ERUPTIONS AND EARTHQUAKES IN ICELAND WITHIN HISTORIC TIMES.*

Translated by GEORGE H. BOEHMER.

Very little account is taken in the Icelandic sagas of nature and its phenomena, yet already at an early day the volcanoes of Iceland have been mentioned. The "speculum regale," written in Norway in 1230–1250, dwells on volcanoes and hot springs in Iceland, and advances some superstitious ideas as to their origin. "The Icelandic Annals" quote volcanic eruptions and violent earthquakes, but without entering into details; and a large amount of information on this subject exists only in manuscript.

The first mention by foreign authors of the volcanoes of Iceland are found in the "Topographia Hiberniæ," by Giraldus Cambrensis (1187), and in "Chronicon de Lanercost" (1275), while the earliest descriptions of the island were given in the fifteenth and sixteenth centuries. In these the most absurd ideas regarding Iceland and other northern countries are advanced, and unlimited fancies and superstitions are displayed as regards the Hecla. At about the middle of the sixteenth century the brothers Johannes Magnus and Claus Magnus wrote about Iceland, and at about the year 1600 *Georg Peerson and Blefkenius* published some volumes on the same island, in which they distinguish themselves by their ridiculous accounts and illusions. They were reported by the Icelandic scientist, Arngrímr Jónsson (1568–1648), who, in several works, endeavored to give the foreigners a correct idea of the country. But it is only since the middle of the eighteenth century, and only by the efforts of Thormodhr Torfason (+1719) and Arni Magnússon (+1730) that the north has commenced to take an interest in the language and the history of Iceland. Ole Worm was the first, in Denmark, to write something on the remarkable nature of that country. Nevertheless the knowledge of it was but very imperfect until the middle of the eighteenth century. In 1746, Johan Anderson, burgomaster of Hamburg, published a volume on Iceland, in which he corrected many inaccurate ideas, and which was followed by the publication, in 1752, of Niels Horrebow's excellent work "Tilforladelige Efterretninger om Island." But no work has ever served a better purpose than the "Reise igjennem Island," Soro, 1772, by Eggert Ólafsson and Bijarni Pálsson; it has been translated into French and German, and notwithstanding its antiquity, it is still the best source of knowledge of this country. At the close of the last century the island was visited by several naturalists, among whom we mention N. Mohr and Sveinn Pálsson, of whom the latter has left some still unpublished works on the volcanoes and glaciers of Iceland.

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* Translation of the résumé of "Oversigt over de islandske Vulkaners Historie af Th. Thoroddsen, Laerer ved Realskolen paa Mödhruvellir, Island."

The geology of Iceland was not thoroughly studied until the commencement of the nineteenth century. Among those who devoted themselves to this subject we must mention G. S. Mackenzie (1810), C. Krug von Nidda (1833), and Eugène Robert, who, in 1835-'36, was a member of de Gaimard's expedition. Steenstrup, Hallgrímsson, and Schythe visited Iceland in 1839-'40, during which period Steenstrup investigated the fossil plants of the miocene period, which later were described by Oswald Heer in his "Flora fossilis arctica." Björn Gunnlaugsson also contributed considerably to the knowledge of the country by constructing, during the years 1831-1843, a map of the island. In 1846, the year following the last eruption of Hecla, the island was visited by three celebrated scientists, R. Bunsen, Des Cloizeaux, and Sartorius v. Waltershausen, and during their sojourn they achieved considerable scientific results. Th. Kjerulf visited the island in 1850 and G. G. Winkler in 1858. The geologist, F. Zirkel, who explored the island in 1860, furnished very valuable contributions to the knowledge of the rocks of Iceland. The "Reise nach Island," by Preyer and Zirkel, is one of the best descriptions known. Paijkull (1867) constructed the first geological map of Iceland, and F. Jonstrup, during his two visits in 1871 and 1876, studied several volcanoes and sulphur and coal beds.

Halldór Jakobsson (1734-1810) was the first to occupy himself with the history of the Icelandic volcanoes, but his work has not been of much utility, on account of the frequent inaccuracies in the location of volcanoes and the dates of their eruptions. G. Garlieb was engaged in similar studies, but his work, too, contains many inaccuracies. Eugène Robert, Sabine Baring-Gould, and Zirkel have partly fallen into the same mistakes as the preceding authors. The information having mostly been obtained in an indirect way, it is not to be wondered at that the results are faulty. The Icelandic poet and naturalist, Jónas Hallgrímsson, was the first to give a true account of the history of the Icelandic volcanoes, but his memoir only exists in manuscript. Many Icelanders have given accounts of various volcanic eruptions during the past century, but the greater part of these observations are still unpublished, and are preserved in libraries or otherwise. As regards the eruptions of the nineteenth century, J. G. Schythe has given an excellent account of that of Hecla in 1845, and F. Jonstrup has described the volcanoes of Dyngjufjall, Sveinagjá, and Mývatn.

Notwithstanding the many celebrated scientists who have visited Iceland, its geology is at present but little known, but this finds an explanation in the extent of the country, in the many difficulties which present themselves to the traveler, and the limited time at their command.

LOCATION OF THE ACTIVE VOLCANOES.

The interior of Iceland forms a plateau of about 630 meters in height, which, towards the north, northwest, and east, is cut up into a large number of fjords and valleys; it slopes gently towards the north-northeast (with a mean inclination of 0° 23′ 52″ between Vatnajökull and the promontory of Tjörnes); and toward the southwest (with an inclination of 0° 13′ 1″ between the plateau of Sprengisandr and the mouth of the Thjórsá); while the steepest slopes are on the east and northwest sides, where they form abrupt cliffs facing the sea. The most elevated portions are covered with glaciers, which occupy a superficial surface of 14,000 square kilometers; the currents of lava covering 7,400, of which 3,400 result from the Ódádahraun. Two chains of volcanic mountains, the Reykjanes and the Snaefellsnes, extend on both sides of the Gulf of Faxe easterly across the plateau. The formation of the east and northwest portions of the island is mostly trap, while that of the central portion is soft gravel, with banks of palagonite, a formation in which the volcanic phenomena seem to be prevalent. Volcanic eruptions appear to be confined to two localities, one in the south of the island, running southwest to northeast, and the other in the north, running from south to north. Eruptions of trachyte have occurred in the eastern portion of the island. Glacial and alluvial deposits cover large spaces. There are a large number of extinct volcanoes; but we shall confine ourselves to those which have been active within historic times.

We may distinguish eight groups of active volcanoes in Iceland:

(1) *Group of Snaefellsnes* (Eldborg).

(2) *Group of the Hecla* (Hecla, Randhukambar).

(3) *Group of Reykjanes* (Thurrárhraun, Trölladýngja, Eldeyjar).

(4) *Group of Katla* (Katla, Eyjafjallajökull*).

(5) *Group of Varmárdalr.*

(6) *Group of the volcanoes south of the Vatnajökull* (Óraefajökull, Skeidharárjökull, Grímsvatn, Sídhujökull).

(7) *Group of the volcanoes of Ódádahraun* (Kverkfjall, Dýngjufjall, Sveinagjá).

(8) *Group of the volcanoes of Mývatn* (Krafla, Leirhnúkr, Hrossadalr, Bjarnarflag, Dalfjall).

(1) *Group of Snaefellsnes.*—The only active volcano in this group is the *Eldborg* (64° 47′ Lat. N., 34° 54′ Long. W. of Copenhagen), which at about the year 950 threw out from a crater of 200 meters in diameter and 53 meters depth a current of lava 11,300 meters long by 3,770 meters wide.

(2) *Group of the Hecla.*—The *Hecla* (63° 59′ N. Lat. and 32° 19′ Long.

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* Jökull is the Icelandic word for glacier. Eyjafjallajökull, for instance, signifies the glacier of Eyjafjall, but at the same time serves to designate the volcano or mountain of that name.

W. of Copenhagen) is the most celebrated of the Icelandic volcanoes. It has been studied by Schythe and Kjerulf. It is located on a chain of 23,000 meters in length, rises in three or four terraces to a height of 1,556 meters, and is surrounded by large lava beds of 680 square kilometers in extent. A little below the summit are craters which, in 1845, were formed in a crevice running southwest to northeast. Parallel with the Hecla emerge from the lava five ridges of soft gravel stone, all running, partly disconnected, from southwest to northeast; in the midst the Hecla rises on a base of 630 meters. The largest streams of lava are found on the east slope of the Hecla, on which side the base also is more elevated than on the west side. Several series of craters appear around the Hecla, and at the foot of the chains of soft gravel stone. At Torfajökull, to the east of the Hecla, the remarkable trachyte lava current of Hrafntinnuhraun* is met with. The Hecla has had eighteen eruptions within historic times.

The *Randhukambar* (64° 12′ N. Lat., 32° 25′ Long. W. of Copenhagen) is a volcano extending, like the Hecla, in a direction southwest to northeast. Only one eruption (in 1343) is known to have occurred, whereby a formerly very fertile valley became covered with ashes and pumice stone.

(3) *Group of Reykjanes.*—The peninsula of Reykjanes should be considered a continuation of the Hecla. It is composed of stratified masses; gravel, alternating with trap-rock, forming plateaus of about 125 meters in height, completely covered with lava, from which rise, in a direction from southwest to northeast, a series of volcanoes and cones of scoria, reaching to a height of 630 meters, containing several hot springs and solfatares. Here, in N. Lat. 64° and W. Long. 33° 55′, one meets with the lava stream of *Thurrárhraun*, dating from the year 1000. It started from two craters situated in the northwest portion of the Hellisheidhi and extended to a distance of 15 kilometers. In its southeast portion, 4 kilometers long, it has an inclination of only 1° 50′, but it then descends with an inclination of 24° to 30°, and from a height of 140 meters into the plain of Ólfus. Nearly in the middle of the peninsula, in 63° 56′ N. Lat. and 34° 14′ Long. W. of Copenhagen, there rises to the northwest of the solfatare of Krisuvik the volcano of *Trölladýngja.* The Icelandic annals mention six eruptions of the Trölladýngja, which have been credited to the volcano of Ódádhahraun of the same group, but which, according to the investigations of Jonás Hallgrímsson, appear to be those of the Reykjanes. On the southwest point of Reykjanes are several hot springs, and in the same direction, about 11½ kilometers from the coast, a series of volcanic islands, known under the name of *Fugles Kjaer* or *Eldegar*, in the neighborhood of which several submarine eruptions have occurred.

(4) *Group of Katla.*—Upon the grand glaciers of Mýrdalsjökull (1,320 square kilometers), separating the district of Skaptafell (Skaptafells-

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* Hraun designates in Icelandic a current of lava.

syssel) from that of Rangárvalla, are located two centers of eruption, the *Eyjafjallajökull* and the *Katla.* The neighborhood of this group consists of sandy deserts and bowlders, which have their origin in the glacial movement and in volcanic eruptions. The configuration of several districts have in this manner been entirely changed within historic times. The combined power of the glacial movement and of the volcanoes is plainly seen in many instances. At one place where formerly quite a considerable fjord existed, there is at present a desert, and several small mountains which formerly rose from the coast are at present quite a distance away from the sea. The Eyjalfjallajökull (63° 37′ N. Lat. and W. Long. 32° 16′ 18″), to the west, is a truncated cone of 1,706 meters in height. The principal crater has tumbled in and is filled up with ice. The eruption of 1821 took place from a crevice of about 50 meters, on the northwest slope of the mountain. The *Katla* (63° 37′ N. Lat., 31° 35′ W. Long. is a deep crater, situated in the eastern portion of the Mýrdalsjökull, and ordinarily filled with ice. It has several times been attempted to closely examine this volcano, but always in vain.

From the Katla, descending to the base of the glacier, extend two valleys, the one in a southeasterly direction, towards the Mýrdalssandr, beyond the isolated mountain Hafrsey, the other one in a southwesterly direction, towards the Sólheimasandr. The greater part of the water-courses issuing from the glaciers at the time of the eruptions descend through the valley to the southeast; still some few find their way through the southwesterly valley. The eruptions which in the annals have been ascribed to the Mýrdalsjökull, Midhdalsjökull, Høfdhajökull, Sølheimajökull, and Katla, should all be credited to the Katla, since all these names have been given to the same volcano. Several districts and a large number of farms have been destroyed by the eruptions of the Katla. Neither the Katla nor the other ice-covered volcanoes in the south of Iceland have ever emitted any lava. This, next to the Hecla, is the most active volcano, twelve or thirteen eruptions having been recorded within historic times.

(5) *Group of Varmárdalr.*—The most violent eruptions ever recorded in Iceland within historic times occurred in 1783, to the northeast of the glacier of Mýrdalr, in the neighborhood of the sources of the Skaptá. These eruptions issued from a large number of craters, situated to the southwest, north, and east of Mont Laki (64° 2′ N. Lat.), and throughout a valley named Varmárdalr, and not from the Skaptárjökull, as mentioned in most geological manuals, although it is not implied that on other occasions eruptions have not taken place from craters in that region of glaciers. The craters which occupy our attention in the present case are but imperfectly known. Magnús Stephensen (1784) and Sveinn Pállson (1794) examined several of them superficially. Those of the valley of Varmárdalr extend throughout a length of about 15 kilometers. The currents of lava which were formed are the most extensive

ever produced in the world in any single eruption within historic times. They cover a track of 397½ square kilometers, and in several places are from 157 to 188 meters thick. The lava spread towards the south in two branches, the westerly one, 83 kilometers long, into the bed of the Skaptá, and the easterly one, 38 kilometers long, into that of the Hoerfésfljót. According to Lyell its volume is considerably larger than that of Mont Blanc; its mean inclination, according to Elie de Beaumont, is 0° 30′; but in the absence of exact measurements these figures can be relied on only approximately.

(6) *Group of volcanoes south of the Vatnajökull.*—On the south side of the Vatnajökull, in an unknown desert, are several volcanoes, but none of them have as yet been examined, and even their exact location is not known, with the exception of the highest mountain in Iceland, the *Óræfajökull*, or Hnappafellsjökull (64° 0′ 48″ N. Lat. and 29° 20′ 16″ Long. west of Copenhagen), which rises like a promontory on the south brink of the Vatnajökull to a height of 1,960 meters. Formerly human habitations extended to the foot of the glacier, but these regions have been completely devastated by the eruption of 1349. Pálsson ascended the Óræfajökull in 1793. From all sides extend large glaciers down to the low lands. To the west of the Óræfajökull is the glacier of *Skeidharárjökull*, and still farther to the west that of *Sidhujökull;* between these is the lake of *Grímsvátn.* The annals mention several eruptions in this region, but exact data are wanting.

(7) *Group of volcanoes of Ódádhahraun.*—To the north of the Vatnajökull is the grand lava current of *Ódádhahraun*, covering a surface of 3,400 square kilometers, and on which a considerable number of craters and volcanoes are located, the greater part of which are still unexplored. The height of the Ódádahraun, above the sea, at the foot of the Vatnajökull, is 942 meters, but on the inner side only 471 meters. To the north of the Vatnajökull, in W. Long. 29° 30′, is the volcano *Kverkfjall*, from which eruptions took place in 1717 and 1873, and likely quite frequently within historic times. To the northwest of the Kverkfjall rises, at an elevation of 1,400 meters above the sea level, the volcanic group of *Dýngjufjall*, explored by F. Jonstrup in 1876. These mountains encircle the valley of *Askja*, which has a surface of about 57 square kilometers, and an altitude of 1,100 to 1,200 meters. The ground is covered with lava beds having, in the east, towards the opening of the valley, an inclination of 1° 26′. In the southeast angle of Askja an abyss of 230 meters depth has formed, in the middle of which is found a circular lake of 1,200 meters in diameter, with a water temperature, in 1876, of 22° C. On the sides of this pit are craters which erupted in 1875.

To the north of the Dýngjufjall mountains, to the west of Jökulsá í Axarfirdhi, in a flat and sterile plain, named *Mývatnsöraefi*, in which there are some ancient craters, an eruption took place in 1875 in the crevice of *Sveinagjá*, in the midst of a grassy plain, whereby a current of lava was created, 23,000 meters long and 1,900 meters wide, the volume of which, according to F. Jonstrup, represents 310,000,000 of cubic meters. The craters are divided into three groups, of which the southerly is 475 meters, and the northerly 422 meters above sea level. The highest crater extended in 1876 to 34 meters above the plain.

(8) *Group of the volcanoes of Mývatn.*—The surroundings of the lake Mývatn constitute a very remarkable volcanic region; it is nearly entirely covered with lava beds strewn over with craters, which give it the appearance of a lunar landscape. To the east of the farm of *Reykjaklidh* stretches out a long chain which terminates in the volcano of *Leirhnúkr*, in the neighborhood of which the grand eruptions of 1724–1730 took place. Into the same period fall other eruptions, issuing from the *Krafla*, to the east of the Leirhnúkr, from the *Hrossadalr*, the *Bjarnarflag*, and from another crater in the vicinity of the *Reykjahlídharsel*, on the east slope of the chain of *Dalfjall*, craters all within a short distance from each other and in a right line south of the Leirhnúkr. Several extensive solfatares occur in the vicinity, especially at Námafjall. The annals mention besides, still without indicating the locality, several eruptions, the greater part of which undoubtedly have taken place in the unknown regions which surround the Vatnajökull.

The various lists indicate quite a number of volcanic eruptions in sections, in which, according to the annals, such phenomena have not occurred within historic times. Likewise one might discard the following localities as places of eruption: Ásmundarnúpr, Thóreyjarnúpr, Hofsjökull, Balvjökull, Theistareykir, Fremri-Námar, Hverfjall, Sandfellsjökull, Mosfell, Herdhubreidh, Skaptárjökull, Breídhamerkrjökull, Thórsmörk, and Torfajökull. It is true, there are craters in some of these localities, but there is not one historical proof of their eruptions. The foreign publications repeat many errors relative to the situations of the volcanoes of Iceland, caused by the imperfect knowledge which their authors possessed of the topography of this country.

CHRONOLOGICAL LIST OF VOLCANIC ERUPTIONS AND EARTHQUAKES IN ICELAND.

900 (approximately). Eruption of the *Katla*. The entire region from the Eyjará and the Hólmsá to the river Kálm, north of the Alptaver, and the district of Dynskógahverfi were completely devastated. At about the same time the sandy plain of Sólheima appears to have been subjected to the action of water and ice, whereby the course now called Jökulsá á Sólheimasamli seems to have been formed. Several lists multiply this eruption, dating them in 894 and 934, but there is no certainty as to the correctness of these dates.

950 (approximately). Eruption of the *Eldborg* and formation of the lava current of Borgarhraun. The farm of Hrípr formerly stood on the site of the present crater.

1000. Eruption on the *Hellisheidhi* and formation of lava stream of Thurrárhraun.

1013. Earthquake, causing the loss of eleven lives.

1104. First eruption of the *Hecla.*

1151. First eruption of the *Trölladýngja.* Several buildings were destroyed by shocks of earthquake.

1157. Second eruption of the *Hecla,* on the 19th of January, and earthquake shocks, causing the death of several persons.

1167. Earthquake at *Grímsnes,* with a loss of nineteen lives.

1182. Earthquake. Eleven people killed.

1188. Second eruption of the *Trölladýngja.*

1206. Third eruption of the *Hecla,* December 4, lasting until the following spring.

1211. Submarine eruption near *Eldeyjar,* southwest of Reykjanes. Several new islands formed and others disappeared. In the south of Iceland an earthquake, whereby eighteen people lost their lives.

1222. Fourth eruption of *Hecla.*

1225. Eruption in some unknown locality. The winter of this year is called "the winter of sand."

1226. Second submarine eruption to the southwest of *Reykjanes.*

1231. Third submarine eruption to the southwest of *Reykjanes.*

1238. Fourth submarine eruption to the southwest of *Reykjanes.*

1240. Fifth submarine eruption to the southwest of *Reykjanes.* According to Gísli Oddsson half of the peninsula was destroyed.

1245. Second eruption of the *Katla.* Torrents of water were thrown upon the plains of Sólheima and the fields were covered with cinders to a thickness of 16 centimeters.

1260. Violent earthquake shocks in the north of Iceland.

1262. Third eruption of the *Katla.* The volcano hurled out a mass of water, ice, and stones,* which, it is said, raised the Sólheimasandr 38 meters. (?)

1294. Fifth eruption of the *Hecla,* accompanied by violent earthquakes and formation of crevices. The water in the wells assumed a milky white color and the Rangá changed its course. The rivers were covered with dross, which the currents carried as far as the Faroe Islands. Several hot springs disappeared on this occasion, while others were formed.

1300. Sixth eruption of the *Hecla,* on the 10th of July. This was one of the most violent actions of this volcano. The cinders thrown out were carried by the prevailing southwest winds to the north of the island, where they caused great destruction, which was followed by a famine. For two days complete darkness prevailed, and the Hecla underwent considerable changes. On the 30th December an earthquake destroyed the farm of Skardh. Five hundred people, mostly in the north of the island, died of the consequences of this eruption.

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* These torrents of water, ice, stones, gravel, and sand, produced by the volcanic eruptions in Iceland, are called "Jökellöb."

1308. Earthquakes in the south of Iceland, destroying eighteen farms and killing six people.

1311. Fourth eruption of the *Katla*, on the 25th of January, completely ravaging the district of Lágeyjárhverfi. Earthquake shocks on the 10th and 11th of January destroyed fifty-one farms.

1332. Eruption in the vicinity of the district of *Sidha* on the 2d of December. The exact spot has not been located.

1339. Earthquake on the 22d of May, in the south of the island, destroying a number of farms above Skeidh, Flói, Holtamannahoeppr, and between the Thjórsá and the Eystri Rangá. In the mountains of Hengil a hot spring appears, with a circumference of 75 meters.

1340. Third eruption of the *Trölladýngja*.

1341. Seventh eruption of the *Hecla*, on the 19th of May, accompanied by an enormous fall of cinders, which devastated several districts in the surrounding country, while at the same time an earthquake destroyed several farms. In the same year an eruption of the *Óraefajökull* is mentioned.

1343 (approximately). Eruption of the *Randhukambar*. In the adjoining valley of Thjórsárdalr eleven farms were completely destroyed. Of some of them the ruins are still in existence.

1349. Second eruption of the *Óraefajökull*, which devastated five fertile districts (Herreder). After the ice covering the mountains began to melt, the torrents thus formed swept away forty farms and two churches, and those which bent their course towards the sea carried such a quantity of sand and gravel that a beach had formed after the eruption at a place where before the water had a depth of 56 meters. Some lists give the dates of this eruption in the years 1350 and 1362, respectively.

1360. Fourth eruption of the *Trölladýngja*. Pumice stone was carried westward, towards the sea, as far as Mýrar, and the eruption was plainly visible at Snaefellsnes.

1370. Earthquake, causing the tumbling down of twelve farm-houses in Ólfus.

1389-'90. Eighth eruption of the *Hecla*. The principal eruption took place from two new craters which opened below the farm of Skardh. It lasted to the middle of the year 1390 and destroyed two farms. The same year saw the fifth eruption of the *Trölladýngja* and one of the *Sídhjökull*.

1391. Earthquakes at *Grímsnes*, Flói, and Ólfus which were felt to the northwest as far as Holtavördhuheidhi. Fourteen farms were seriously damaged and three houses caved in.

1416. Fifth eruption of the *Katla*, with a considerable fall of ashes.

1422. Sixth submarine explosion southward of *Reykjanes*. A new island was formed, which later on disappeared again.

1436. Ninth eruption of the *Hecla*, resulting in the destruction of eighteen farms during one morning.

1477. Eruption in an uninhabited region; in the north of the island a heavy fall of ashes followed by a famine.

1510. Tenth eruption of the *Hecla*, on the 25th of July. Large masses of lava were thrown to a distance of several miles, killing several people. In the same year the sixth eruption of *Trölladýngja* is recorded. These eruptions were followed by dangerous epidemics, to which many people fell victims.

1546. Earthquake at *Ólfus*, in the commencement of June. Several farms were more or less injured.

1552. Earthquake on the 2d of February.

1554. Towards the end of May the eleventh eruption of *Hecla*, or rather of the mountain chain forming its northeastern continuance. The eruption lasted six hours, and the shocks of earthquake were so frequent that the people quitted their houses and took up their abodes in tents.

1578. On the 1st of November the twelfth eruption of *Hecla*, which, although feeble, was accompanied by violent shocks of earthquakes which destroyed several farms at Ólfus.

1580. Sixth eruption of the *Katla*, on the 11th of August. Destruction of several farm-houses, but no loss of life. The current of water, ice, sand, and rocks (Jökellöb) thrown out by the volcano took a southeasterly course.

1581. On the 30th of May, earthquake at *Rangárvellir*, demanding several victims.

1583. Seventh submarine explosion southwest of *Reykjanes.*

1584. Violent earthquake.

1597. Thirteenth eruption of *Hecla*, commencing on the 3d of January and lasting until March, while vapor was emitted until July. Eighteen columns of fire rose above the mountain, the cinders scattered over more than half the country, in the west as far as Borgarfjördhr, to the east as far as Lón, and to the north as far as Bárdharvalr, and during twelve hours the detonations were audible at the extreme north of Iceland. The eruption was accompanied by earthquakes, which destroyed several farm-houses at Ólfus. A large hot spring (the Little Geyser) south of the farm of Reykir disappeared, but another one opened on the north side.

1598. On the 10th of November, the third eruption of *Óraefajökull* and eruption at *Grímsvatn* (?). A northeast wind carried the ashes as far as the Eyjafjördhr.

1612. Eruption of the *Eyjafjallajökull* on October 12.

1613. Violent earthquakes in the south of Iceland; destruction of many farm-buildings.

1618. Earthquake at *Thingeyjarsýsla*, continuing from autumn until Christmas. One shock broke down four buildings and produced a number of large crevices.

1619. Fourteenth eruption of *Hecla* towards the end of July. The ashes carried northward by a southwesterly wind produced an intense darkness.

1624. Earthquake at *Flói* in November; two farm buildings were destroyed and a large number damaged.

1625. Seventh eruption of *Katla*, from the 2d to the 14th of September. The "Jökellöb" inundated the plain of Álptaver and surrounded the *Thykkvabaejarklaustr* and neighboring farms. The ashes were carried as far as Bergen, Norway. At Skaptárhunga they collected knee-deep. Two districts were ruined.

1630. Earthquake to the east of *Thjórsa* in winter; six lives lost.

1632. Earthquake in the fall.

1633. Earthquake in the south, above Ólfus.

1636. Fifteenth eruption of *Hecla*, lasting from the 8th of May until the following winter. Thirteen craters were formed. The ashes were carried to the southeast.

1638. Eruption in an unknown locality in the east of Iceland. The water-courses in that section carried to the sea large pieces of pumice-stone.

1643. Earthquake near Christmas.

1657. Earthquake, overthrowing several farm buildings at Fljópehlidh.

1658. Earthquake on Easter day.

1660. Eighth eruption of *Katla*, lasting from the 3d to the 12th November. The powerful "Jökellöb" carried to the sea enormous masses of ice, rocks, and gravel to such an extent that the large sand plains at the foot of the Katla were completely inundated and resembled a stormy sea. The presbytery and the church of Hofdhabrekka were torn away by the waters, the farm of Hofdhi completely demolished, and four other farm buildings damaged to a considerable degree. Fishing grounds of 38 meters depth were filled up by the eruption and formed a dry beach.

1661. Earthquake in summer.

1668. Violent earthquakes in winter.

1671. Earthquakes at *Grímsnes* and Ólfus; several buildings fell in.

1681. Eruption of the *Skeidharárjökull.*

1685. Eruption in the vicinity of lake *Grímsvtan.*

1693. Sixteenth eruption of *Hecla* from four craters; very violent, and lasting from the 13th of February until August. It was accompanied by shaking of the earth, which was even noticeable on the sea. The volcano emitted blocks of lava of the size of houses; the ashes spread all over the island and were transported as far as Norway and Scotland, while the pumice-stone was carried by the streams and currents as far as the Faroe Islands.

1706. Very violent earthquakes in the south, on the 1st and 20th of April, above *Ólfus* and at *Flói,* where twenty-four large farms and a number of smaller buildings were overthrown. The trembling, with diminishing force, was felt beyond the Hecla, at Snaefellsnes,

1716. Eruption in the vicinity of lake *Grímsvatn.*

1717. Eruption of the *Kverkfjall* on the 17th of September. A large portion of the country, to the north and east, was covered with ashes, and the Jökulsá í Axarfirdhi carried to the sea large quantities of pumice-stone.

1721. Ninth eruption of *Katla*, commencing on the 11th of May with a great "Jökellöb." The blocks of ice carried down to the sea, and filling it to a depth of from 130 to 150 meters, formed a barrier to a distance of three nautical miles from the shore. A turf-covered ridge of rock of about 24,000 square meters was cut away on being struck with this giant force. A rocky pinnacle of 38 meters in height was also carried away, and the large cavern of Skípahellir completely filled up with gravel. The wind carried the ashes to the west; and at Saurbaer, upon the Hvalfjardharströnd, 150 kilometers distant, the darkness was so intense as to prevent, at broad noon, the distinguishing of letters in a book. The sailors of Reykjanes, 188 kilometers from the Katla, were barely able to find the entrance of the harbor at the beginning of the eruption. It lasted during the summer and fall.

1724–'30. During this period several eruptions took place in the vicinity of lake *Mývatn.*

1724. Eruption of the *Krafla*, 17th of May. The crater of Viti, on the west slope of the mountains, emitted an enormous qnantity of ashes, and to the east of lake Mývatn it formed a bank 1 meter deep. The shocks were felt throughout the entire country; houses were overthrown, and the contour of the country changed by the formation of elevations and depressions.

1725. January 11, eruption of *Leirhnúkr*, with much shaking of the earth, and on April 19 eruption of *Bjarnarflag.* The earthquakes, increasing in force, attained their maximum intensity on the 8th of September. In the same year an eruption of *Skeidharárjökull* took place.

1727. Eruption of *Óraefajökull*, lasting from the 3d of August, 1727, until the 25th of May, 1728. Powerful "Jökellöb" devastated the entire country below the mountains, and carried out into the sea a large number of horses and other animals. The *Skeidharárjökull* was, at the same time, much agitated. On the 21st of August another eruption took place from the *Leirhnúkr*, throwing out a current of lava, which took a northerly direction.

1718. Eruption of the *Leirhnúkr*, at 2 a. m. of the 18th of April, with a flow of lava, which almost reached lake Mývatn. Four hours later a new crater opened to the south of Leirhnúkr, in the *Hrossadalr*, and at about the same moment the *Bjarnarflag* erupted. Two days later a crater, situated on the east slope of the *Dalfjall*, near the *Reykjahlídharsel*, emitted a large current of lava. On the 18th December another eruption of the *Leirhnúkr.* In the same year several volcanic phenomena were observed in the lava beds of *Hecla.*

1729. The *Leirhnúkr* again became active on the 30th of January, and eruptions took place during the entire year. The lava advanced to the lake Mývatn and demolished the presbytery of Reykjàlídh, together with three other buildings. One current emptied itself into the lake and a terrible combat took place between the elements.

1732. Earthquakes at *Rangárvellir* and at Eystrihreppr, on the 7th of September, by which forty farm buildings were more or less damaged and eleven or twelve nearly overthrown. These shocks continued during two weeks.

1734. Earthquake shocks at *Flói* and other localities in Arnessyssel, by which thirty farm buildings were overthrown, sixty to seventy damaged, and seven or eight people killed.

1749. Earthquakes at *Ólfus* and *Borgarfjördhr;* the flow of the hot spring of Skrifla diminished and the farm-house of Hjalli, at Ólfus, together with the church, sank 1.25 meters below the surface.

1752. Earthquake in *Árnessyssel;* 12 farms in Ólfus damaged, and one church overthrown.

1753. Eruption in the vicinity of *Sédhujökfll.* A "Jökellöb" produced in the river Djúpá, which flows in a gorge towards the presbytery of Kálfafell, a rise of 60 meters; an inundation followed which devastated the entire surrounding country. The waters of the Skaptá and of the Hverfisfljót rose proportionately. The ashes were carried beyond Skaptártunga.

1754. Volcanic phenomena of three hours' duration in the lava beds west of the *Hecla.*

1755. Sixteenth eruption of *Katla*, preceded in the north by violent shocks of earthquake, overthrowing 13 farm-houses situated mostly in the neighborhood of Húsavík, and lasting from the 10th to the 16th September. The eruption commenced on the 17th October and lasted until August, 1756. The "Jökellöb" and the ashes, which were carried as far as Leirá, in the Borgarfjördhr, to the west, and to Djúpivogr to the east, occasioned great damages. A large part of Skaptafellssyssel was covered with a layer of ashes 15 to 20 centimeters in thickness, and fifty farms had to be abandoned. In consequence of this eruption two ridges were formed on the Mýralssandr, 23,000 meters long, 40 meters high, and composed of ice, pumice stone, mud, and ashes.

1766. Seventeenth eruption of *Hecla*, commencing on the 5th of April, as ordinarily with heavy earthquake shocks, perceptible southwestward as far as Reykjanes. The ashes drifted northwest and caused darkness in the north of Iceland; the layer of ashes formed was 60 centimeters thick in the vicinity of the volcano, and 30 centimeters at 225 kilometers distant, but fortunately it fell mostly in uninhabited districts. Pieces of pumice stone of 2 meters circumference were thrown a distance of 15 kilometers, a piece of lava of 1,750 grains a distance of 23 kilometers, and another piece of 3,750 grains weight, struck the frozen ground at Naefrholt with such force that it could only be removed with the aid of a lever. Masses of pumice stone caused the Ytri-Rangá to overflow its banks, and the Thjórsá and other rivers carried enormous quantities of it out into the sea. A current of lava, 7,500 meters long, spread out towards south-southwest. On the 21st of April the ashes measured 5,000 meters in height and still rising. This eruption did not end until the next autumn.

1774. Eruption in an unknown section in the vicinity of the *Skeidharárjökull.*

1783. Eighth submarine explosion southwest of *Reykjanes* in May. An island formed with a crater which emitted such quantities of pumice stone that the sea was covered with it to a distance of 150 to 225 kilometers. This island, which received the name Nyö (new), soon again disappeared.

In the same year grand eruptions took place in the vicinity of the *source of the river Skaptá.* On the first of June a trembling of the earth was noticed throughout Skaptafellssyssel which lasted until 8 a. m. At 9 A. M. a violent eruption was noticed at Sidha in a direction north. At the same time the Skaptá, then 130 meters wide, commenced to diminish rapidly, and on the 11th June it had dried up entirely. On the 12th a current of lava precipitated itself like a roaring sea into the bed of the river, 160 to 190 meters deep, and after filling it up completely, overran its banks, spread in various places and encircled several farms, but was suddenly arrested by a deep pit existing in the bed of the Skaptá between the farms of Skaptárdalr and the Á, and which it would have to fill and bridge over before being able to pursue its course. The emissions of lava continued without interruption, and in the direction of Úlfarsdalr and Varmárdalr twenty-two columns of fire and ashes could be counted. From the 14th to the 22d June the lava currents overflowed each other in the plains south of the Skaptá, destroying several farms and fusing the old lava, at the same time obstructing or dislocating several water courses. Pumice stones and dross were thrown a distance of 113 kilometers westerly to Rangárvallasyssel. On the 30th of June a current of lava turned west, towards the *Kúdhafljót*, one of the largest rivers of Iceland, which arrested it in its course, the current of lava being unable to surmount this powerful barrier. The east branch of this current emptied itself into the Skaptá, bridged over on the 17th of July a deep pit below the cascade of Stapafoss, and stopped on the 20th of July at 1,900 meters from Kirkjubaejarklaustr, where it filled a channel of 130 meters in width and 40 meters in depth. The volcanoes continued their eruptions with diminishing force during the months of July, August, and September, and even in the middle of January of the next year one could still observe from Skaptártunga feeble eruptions behind the mountains. On the 29th of July, 1783, new eruptions were again observed farther to the east, in the district of Fljótshverfi; this region became covered with ashes, and the waters of the Hverfisfljót, after reaching the boiling point, evaporated completely under the action of a current of lava which filled the bed of the river and expanded towards the south, thereby destroying several farms. These eruptions continued until the month of January, 1784. At the same time the volcano in the vicinity of *Skeidharájökull* evinced signs of activity, and an eruption took place on the 8th of April, 1784, giving birth to a terrible "Jökellöb."

These violent eruptions tended to largely change the configuration of the surrounding country. Several water-courses disappeared, others had their course obstructed, and now formed in the lava bed innumerable small lakes, which in the mean time also disappeared, the Skaptá and the Hverfisfljót digging out new beds. And on the other hand no eruptions had ever had such disastrous consequences for Iceland. The lava consumed entirely 9 farms, ruined about 29 others, and rendered two parishes uninhabitable for two years. The ashes extended in large masses over the greater portion of Iceland and were carried to the Faroe Islands and beyond. The prairies were devastated, and a large number of animals died of hunger and disease. The year following was still more sorrowful, the inhabitants dying by the hundreds of hunger. It has been estimated that of the 48,884 individuals composing the inhabitants of Iceland, 9,238 died in consequence of these eruptions. Of animals, the loss by death during the years 1783–'84 was: 11,461 head of cattle, 190,448 sheep, and 28,013 horses. Iceland was unable to recover from these terrible misfortunes until the middle of the present century.

1784. From the 4th to the 16th of August violent earthquake shocks in *Árnessyssel* and *Rangárvallasyssel.* In the former 69 farms were completely destroyed, and 372 more and 11 churches badly damaged. In the latter 94 farm-buildings were shaken down. In some localities hot springs disappeared and reappeared, and near the geyser 35 new springs formed.

1789. Violent earthquake at *Árnessyssel.* The lava beds of Thíngvellir underwent some changes, and the entire section of land between the crevice of Almannagjá and Hrafnagjá settled 60 centimeters. Hot springs sprouted up on the Hellisheidhi and in other localities (for instance at Reykir). Several farms in the southeast of Iceland tumbled down.

1808. Earthquakes in various places of Iceland, accompanied by a change of the hot springs.

1810. Earthquake to the west of *Hecla* October 24.

1815. Earthquake shocks in the north part of the island during the month of June.

1818. Feeble earthquake shocks in the southern part of the island.

1821. Second eruption of the *Eyfafjallajökull,* commencing on the 19th

December and continuing, though feebly, until the 1st of January, 1823. It produced a "Jökellöb," which, taking a westerly course, occasioned considerable damages.

1823. The eleventh eruption of *Katla* lasted from the 26th of June to the 23d of July, but was not as violent as the previous ones of the same volcano. A "Jökellöb" carried to the east a large quantity of sand and gravel. In the beginning of February of the same year some volcanic phenomena were observed in the vicinity of the sources of the Skaptá, possibly within the volcano of 1783.

1826. Earthquake shocks in the north of Iceland during the month of June.

1829. Earthquake shocks in the south of Iceland on the 21st and 22d of February; nine farms were destroyed.

1830. Ninth submarine explosion southwest of *Reykjanes*, at 4 kilometers southwest of Eldeyjarbodi and at 60 kilometers southwest of the point of Reykjanes. The explosions continued from the 13th of March until the month of May.

1838. Earthquake in the north and south of Iceland, in the north between Skjálfandi and Húnaflói, with change of location of hot springs.

1839. Earthquake at *Reykjavík*, on the 28th of July.

1845. Eighteenth eruption of *Hecla*, which, commencing on the 2d of September, lasted for seven months. A large quantity of ashes spread over the surrounding country, and a portion was carried by the wind as far as the Shetland islands. The column of ashes, on the 5th of February, 1846, rose, according to *Gunnlaugsson*, 4,370 meters above the summit of Hecla. The current of lava emitted had a length of 11,300 meters, a width of 2,800 meters, and was from 15 to 35 meters thick. J. G. Schythe estimates its bulk as 446,000,000 of cubic meters.

1855. Feeble earthquake shocks in the north of Iceland.

1860. Twelfth eruption of *Katla*. On the 8th of May, between 6 and 8 A. M., an earthquake occurred, followed by a "Jökellöb," descending from the Katla towards the southeast. On the 11th another "Jökellöb" from the Sólheimasandr towards the southwest. The eruption ceased on the 27th of May. The "Jökellöb" carried such large masses of sand and gravel that a former fishing ground of 30 meters' depth was completely filled up after the eruption. The ashes were transported towards the north into uninhabited regions and did but little damage. On September 20, at 7 P. M., an earthquake in the south, moving southwest to northeast. In the night from the 30th to the 31st December one noticed at Reykjavík a movement in the same direction.

1862. Eruptions in the uninhabited regions north of the *Vatnajökull*, but its exact location not known.

1863. Earthquake at *Reykjavík*, in the night of the 20th to the 21st of April.

1864. Earthquake at *Reykjavík*, on the 16th of February.

1867. Eruptions in the inhabited regions north of the *Vatnajökull*, from the 29th of August to the 5th September. Fall of ashes south of the Vatnajökull, at Óraefi, and at Sudhrsveit. At the same time "Jökellöb" at *Skeidharárjökull.*

1868. Towards New Year some volcanic phenomena at *Manáreyjar*, in the north of Iceland, were observed at sea in the neighborhood of Tjörnes; and at the same time an earthquake took place at Húsavík. In January, feeble shocks in the north; on the 1st to the 3d November earthquake shocks in the south.

1872. Severe earthquake in the north, at *Húsavík*, on the 17th of April. Several buildings were overthrown and others damaged. The shocks were not discontinued until the end of May. In December of the same year some feeble shocks were observed in the north.

1873. Eruption of the *Kverkfjall* (?) January 8 to 13. Considerable fall of ashes in the south and east of the island.

1875. Alternate eruptions of the *Dýngjufjall* and the *Sveinagjá.* Towards the end of 1874 some earthquakes were noticed in the northeast of the island, and on the 3d of January a column of smoke was observed to rise above the *Dýngjufjall*, but this eruption did not cause any damage. According to the researches of F. Jonstrup it issued from craters situated in the southwest corner of the *Askja*, 94 meters below the lava field of Askja, and 138 meters above the lake. These craters emitted an enormous quantity of vapor even during the summer of 1876. During the first eruption large blocks of tuft and basalt, some of a bulk of 31 cubic meters, were thrown to a height of 30 meters, and one of them emitted blocks of gravel, cemented with ice, of a bulk of 6 cubic meters.

On the 18th of February occurred an eruption of the *Sveinagjá*, in the Mývatnsöraefi (desert of Mývatn), and the formation of several craters; on March 10, an eruption of 14 to 16 new craters, emitting torrents of lava; and on the 29th of the same month a violent eruption of the *Dýngjufjall.* The entire eastern portion of Iceland became covered with ashes and pumice stone, the bulk of the latter having been estimated at 400 millions of cubic meters. Portions of the ashes were transported to Norway, and even at Stockholm and its vicinity a shower of the ashes fell on the evening of the 29th of March. This eruption issued from the most southerly crater of the valley of Askja, to the northeast of the pit mentioned before. The ground all around was, in 1876, covered with pumice stones, the larger portion of them having a diameter of 15 to 20 centimeters, and many of 50 to 100 cubic decimeters in bulk. At one place where they were of a thickness of 60 to 100 centimeters they had entirely hidden a bed of snow of 8 meters' thickness, formed during the winter of 1874–'75. On the 4th of April several eruptions were observed on the Mývatnsöraefi, and on the 15th of August the last one occurred, none of them causing much damage. The lava produced was basaltic and very uneven. Some craters emitted bombs with a close surface and a cellular mold. In July, 1876, a temperature of from 130° to 200°, and even 300° C., was observed in the cracks of the lava. In the grass-covered spots which the lava overflowed, crystals of chlorhydrate of ammonia have separated. The eruption of Dýngjufjall, of the 29th of March, had some very severe consequences for the fertile regions of the east of Iceland. Hundreds of farms had to be abandoned, but one also rapidly recovered from the evil effects by removing the light layers of ashes and pumice stone, and the damage will not be as serious as was feared. This eruption, from the fact that its products were purely trachytic, stands isolated and unique in Iceland in modern times.

1879. On the 27th of February an eruption in one of the chains running northeast from the *Hecla.* It lasted to the month of May, without doing much harm, the lava not reaching the inhabited regions.

1879. Tenth submarine explosion southwest of *Reykjanes*, on the 30th and 31st of May.

The following eruptions mentioned in several old lists are charged to the wrong volcanoes: *Hecla*, 1004, 1029, 1113, 1374, 1583, 1625, 1727. *Katla*, 1717, 1727. *Trölladýngja*, 1475. *Herdhubreidh*, 1341, 1510. *Sidhujökull*, 1728. *Óraefajökull*, 1332, 1336, 1720. *Breidhamerkrjökull*, 1362. *Hofsjökull et Baldjökull*, 1716. *Hverfjall* (*or Sandfell*), 1748, 1752. *Raudhukambar*, 1311. *Thórsmörk*, 1310, 1350. *Mosfell*, 1340. *Breidhífjördr* (*near Snaefellsnes*), 1219, 1345. *Thingvallahraun*, 1587. As to Helgafell, on the island of Westmanna, no positive data exist regarding eruptions within historic times.

Within historic times eruptions have taken place at about 20 different places in Iceland. Generally speaking the volcanoes are small and only one eruption is on record. Among the large volcanoes, Hecla occupies the first place with 21 eruptions; next comes the Katla with 12 or 13, then the Eldeyjar, near Reykjanes, with 10, the Trölladýngja with 6 eruptions. The largest current of lava was produced in 1783. The ice-covered volcanoes in the south of Iceland never emit currents of lava, but only ashes; they are above all to be dreaded on account of the "Jökellöb" which they produce when the eruption breaks up the covering of ice. The largest number of eruptions have taken place in the fourteenth century (13), and in the eighteenth century (14). In studying the list of eruptions it will be observed that in each period they are concentrated in one certain section and that, in their succession, they rarely made large jumps. The earthquakes are in direct connection with the eruptions, they occurring nearly all in Ólfus, Grimsnes, Flói, and at Fjólshlidh, in the vicinity of the Hecla, or at Thingeyjarsýsla, the hearth of the volcanoes of the north.

All the eruptions mentioned in the annals, and regarding which reliable dates exist, are given in the following list:

Volcanic eruptions in Iceland within historic times.

Eldborg.	Eldeyjar.	Trölladýngja.	Thurrárhraun.	Hekla.	Randhukambar.	Eyjafjallajökull.	Katla.	Varmárdalr.	Sidhujökull.	Grímsvátn.	Skeidharárjökull.	Óraefajökull.	Paa ukjendte Steder i Naerh. af Vatnajökull.	Kverkfjall.	Dýngjufjall.	Sveinagja.	Krafla.	Leirhnúkr.	Hrossadalr.	Bjarnarflag.	Dalfjall.
950	1211	1151	1000	1114	1343	1612	900	1783	1389	1598	1681	1341	1225	1717	1875	1875	1724	1725	1728	1725	1728
	1226	1188		1157		1821	1245	1823	1753	1685	1725	1349	1332	1867				1727		1728	
	1231	1340		1206			1262			1716	1727	1598	1341	1873				1728			
	1238	1360		1222			1311				1774	1727	1477					1729			
	1240	1389		1294			1416				1784		1510								
	1422			1300			1580						1638								
	1583			1341			1625						1862								
	1783			1389			1660														
	1830			1436			1721														
	1879			1510			1755														
				1554			1823														
				1578			1860														
				1597																	
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				1693																	
				1728																	
				1754																	
				1766																	
				1845																	
				1878																	

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Compiled by GEORGE H. BOEHMER.

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2. Printed books.
3. Articles from journals, transactions, &c.
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1. Manuscripts.

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4. MAPS AND CHARTS.

Carte Réduite des côtes d'Islande publiée au Dépôt général de la marine d'après les cartes rédigées par le Contre Amiral de Löwenœrn, directeur du Dépôt Royal des cartes marines de Danemark. 1: 300,000, 6 feuilles, 1822, 1833.

CNOPF. Insulæ Islandiæ delineatio, prout hæc solenni mensurandi negatio sub auspiciis potentissimi Regis Daniæ facto etc, a. 1734 demum. Militarem ad finem deducto debetur, divisæ in quatuor partes, Islandice Fiördung, quarum quævis in suas minores regiunculas, Islandica Sislu, Danice Syssel dictas subdividitur 1: 1,200,000. Norimbergæ, Homan Heredes, 1761.

GUNNLAUGSSON (BJÖRN). Uppdráttr Islands, gjördr ad fyrirsögn Olafs Nikolas Olsens, er stydjast vid príhyrníngamál og strandamälingar pär, sem hid konúngliga Rentukammer hefir látid gjöra og reiknád hfir Hans Jak. Scheel; gefinn út af enn Islenzka bókmentafèlagi. 1: 480,000. Kpfrst. u. color. 4 Bl. u. 1 Bl. Text. Reykjavik og Kaupmannahöfn, 1844. Leipzig, T. O. Weigel, spätere Ausgabe, 1849. Imp. fol.

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Iceland. Map of the Geyser. Scale 25.344 inches = 1 mile. Surveyed and drawn by J. C. Ardagh. 17 Aug., 1867.

Iceland Island. Danish survey, 1845; corrections to 1869.

Island. Kaart over Pollen i Skuttils fjord, 1865. 1: 10,000.

Island, med omgivende Dybder, 1871. Eng. Zoll = 20 Geogr. Meilen.

Island und die Far-Oer-Inseln. Kpfrst. u. color. Weimar, L. J. Compt., 1820. Roy. fol.

Islande, côte nord-ouest. Croquis du mouillage d'Hogdal, dans le Dyre Fjord, West et de sedières, Nr. 1897. Paris, Dépôt de la marine, 1862.

Islande, côte occidentale. Plan de la partie de la côte sud du Brede Bust. Véron, de l'Aulnois, Pillet, Maisse et de Libran. Nr. 1881. Paris, Dépôt de la marine, 1862.

Islande. Plan de Sukutuls Fjord et du Port de Pollen. Croquis du mouillage de Bildal dans Arnar Fjord. Paris, Dépôt de la marine, 1868.

Islande, Spitzbergen, Isle de J. Mayen. Amsterdam, J. v. Keulen, 1689, color.

Islandiæ Tabula, Fernando Bertelè exc., 1566.

Kaart over Island. Efter C. N. Olsens og B. Gunnlaugssons, Uppdráttr Islands (1849), Kopenhagen, Forlagsbureauet, 1866.

Korter over den islandske Kyst, udgivne af Samme, 1788, 1822.

MACKENZIE (G. J.). Südwestküste Islands, nach den besten Angaben u. Beobachtungen, nach Mercator's Projection entworfen. Kfrst. u. color. Weimar, L. J. Compt., 1814, gr. fol.

Nyt Carte over Island forfattet ved Professor Erichsen og Professor Schöning, 1771.

Nyt Carte over Island, von Erichsen und Olavius. 1780. 1: 1,200,000.

PETERMANN. Eine neue Karte der Dänischen Monarchie. 3. Island. 1: 6,000,000. Petermann's Geogr. Mitth., VIII, 1862, p. 227.

REINECKE (J. CHR. MATTH.). Doppelkarte von Island. Kpfrt. Weimar, L. J. Compt., 1801, gr. 4to.

——— Island, nach Murdochischer Projection und den besten astronom. Ortsbestimmungen von Verdun de la Crenne, Pingré u. Bordv. Kupf. u. color. Weimar, 1800, Landes Industrie Comptoir, 1804. Imp. fol.

Voxende Kaart over Island og Færöerne 1826. Rettet til 1859.

GEOGRAPHY.

By J. King Goodrich.

GENERAL NOTES.

The attention of the geographical world has been drawn away from the poles and centered upon the equatorial regions during the short period which has elapsed since the last report of the progress in geography was written. As a summary of the work done, the address of the Marquis of Lorne, president of the Royal Geographical Society of Great Britain, at the opening of the session of 1885–'86, may be very properly alluded to at this point and commended as a careful and satisfactory epitome of what is of most interest.

While lacking much of the harrowing element that was so distressingly conspicuous in the records of the "Jeannette" and Greely Arctic expeditions, and which appealed so strongly to our sympathy, the current record is by no means wanting in evidences of danger and disaster.

The Aberdeen meeting of the Geography Section of the British Association commenced on the 9th of September. The leading feature of this year's meeting was the prominence given to Indian subjects. Out of a total of thirty-four papers read, as many as eleven referred to the geography of India and the regions immediately adjoining it. Geographical education attracted much attention, and the report of Mr. Keltie upon this subject elicited prolonged discussion. The importance of this branch of education is becoming more marked every day; communications on the subject have frequently appeared in the leading journals, which devote columns specially to geography. In order to test the condition of education in Denmark, the Government decided at the beginning of the year to have a test examination among the recruits of the army and navy, on the Belgian principle. The result of this examination appears to have been very discreditable to education in Denmark, and particularly to that in geography. One of the examiners, the Rev. J. L. Bang, of Langaa, has given some particulars of the results, from which we quote: "The regiment selected was the Life Guards, the crack regiment of the Danish army, the recruits (282 in number) being drawn from every part of the country. Questions such as how many ells (the Danish measure) go to a mile, and the size of an acre of land, were answered by a very few only. But as regards geography the answers were far worse. In answer to the question, 'What is the capital of Sweden?' Paris, Trondhjem, St. Petersburg, Amsterdam, London, Madrid, Copenhagen, and even Constantinople were given." It is by no means certain that a similar examination in this country would develop results very much more satisfactory.

Dr. Richard Lehmann, professor of geography in Munster University, has issued the first part of a work, which will extend to about 400 pages, on apparatus and methods in geographical teaching. Dr. Lehmann has given much attention to the subject of geographical education, and has himself, as teacher and Privatdocent in Halle, had great experience in teaching the subject, so that his work when completed is sure to prove of real service.

An exhibition of maps, atlases, reliefs, globes, and other apparatus used in geographical education, collected from the principal establishments and institutions in England and on the continent of Europe, was opened in London on the 9th of December, 1885, by the president of the Royal Geographical Society, the Marquis of Lorne, and will continue to the 31st of January, 1886. The programme includes lectures and discussions, and the attendance and interest confirm the judgment of the promoters of the scheme.

The geographical subject proposed this year by the French Academy of Inscriptions for the *Prix Bordin* is "A critical examination of the geography of Strabo." According to the terms laid down by the Academy, competitors are (1) to give the history of the text of the work; (2) to characterize the language of Strabo with reference to that of contemporary Greek writers, such as Diodorus Siculus, and Dionysius of Halicarnassus; (3) to distinguish the information collected by direct observation of places and that drawn by him from his predecessors; (4) to express definite conclusions on his critical method in using various documents. The papers should be in the hands of the secretary of the institute not later than December 31, 1886.

It was stated in the early part of the year that the King of the Belgians was conferring with M. Martinie, president of the French Geographical Society, on the subject of the formation of an International Geographical Society. Though nothing definite seems to have come of this conference, it is to be hoped that such a society will be formed. One of the best arguments in its favor is that through its instrumentality combined action could be had on the system of orthography for native names of places. Taking into consideration the present want of such a system, and the consequent confusion and variety that exist in the mode of spelling in English maps, the council of the Royal Geographical Society has adopted the following rules for such geographical names as are not (in the countries to which they belong) written in the Roman character. The rules are identical with those adopted for the

Admiralty charts, and will henceforth be used in all publications of the society.

1. No change will be made in the orthography of foreign names in countries which use Roman letters: thus Spanish, Portuguese, Dutch, &c., names will be spelt as by the respective nations.

2. Neither will any change be made in the spelling of such names in languages which are not written in Roman character as have become by long usage familiar to English readers; thus Calcutta, Cutch, Celebes, Mecca, &c., will be retained in their present form.

3. The true sound of the word as locally pronounced will be taken as the basis of the spelling.

4. An approximation, however, to the sound is alone aimed at. A system which would attempt to represent the more delicate inflections of sound and accent would be so complicated as only to defeat itself. Those who desire a more accurate pronunciation of the written name must learn it on the spot by a study of local accent and peculiarities.

5. The broad features of the system are that vowels are pronounced as in Italian, and consonants as in English.

6. One accent only is used, the acute, to denote the syllable on which stress is laid. This is very important, as the sounds of many names are entirely altered by the misplacement of this stress.

7. Every letter is pronounced. When two vowels come together each one is sounded, though the result when spoken quickly is sometimes scarcely to be distinguished from a single sound, as in ai, au, ei.

8. [East] Indian names are accepted as spelt in Hunter's *Gazetteer.*

On the 11th of September occurred the centenary of the foundation of the well-known geographical establishment of Justus Perthes, of Gotha. The committee of the Geography Section of the British Association, which was in session at Aberdeen at the time, sent a telegram of hearty congratulation and good wishes for the future to the head of the establishment. All the professors of geography at the German universities united in presenting to the firm a beautifully illuminated address, expressing their sense of the services rendered to geography by the firm during its long career. A handsome quarto volume has also been issued from Gotha for private circulation, giving a very interesting sketch of the progress of the establishment under its various heads, brief biographies of the famous cartographers connected with it, and notes on the various great works in geography which it has produced. The work contains numerous portraits both of the partners and cartographers of the past. The founder of the firm was Johann Georg Justus Perthes, who was born at Rudolstadt, September 11, 1749, his father being physician to the Prince of Rudolstadt. When the firm was first established in Gotha in 1785, its publications were of a general character. In 1809 the great *Hand-Atlas über alle bekannte Länder des Erdbodens*, by Professor Heusinger, of Dresden, was published, with twenty-four maps in copper plate. Under the second chief of the firm, Wilhelm Perthes, 1816–'53, the

Gotha establishment rapidly assumed the special geographical and cartographical character it has ever since possessed. Under him the first part of the celebrated hand atlas of Adolf Stieler was published in 1817, which since then has continued to be issued in an unbroken series of editions. To Wilhelm succeeded in 1853 Bernhard Perthes, who, however, was cut off in 1857, leaving a posthumous son, the present head of the Gotha establishment. The successive chiefs gathered round them in successive years all the best geographical talent in Germany, including such names as those of Stieler, Berghaus, Sydow, Spruner, Bretschneider, Petermann, Behm, Wagner, Supan, Hassenstein. Through the *Geographische Mittheilungen* established by Petermann, the Gotha establishment has gradually become the receptacle for geographical information from all parts of the earth, information which is being constantly put on record and given to the world in the form of those accurate and beautiful maps with which all geographers are familiar. It is to be hoped that long continued prosperity is in store for a house which has done such admirable service in the past to geographical science.

The recent colonial acquisitions by the various European nations has called forth a number of excellent papers on the subject. Among the best is that of Colonel Sir Charles H. Nugent, K. C. B., which was published in a recent issue of the Journal of the Royal United Service Institution. According to the latest statistics, England has 65 square miles of colony to the square mile of her own area; Holland, 54; Portugal, 20; Denmark, 6·30; France, 1·90; and Spain, 0·86 square miles. The area of the British colonies is nearly 8,000,000 square miles, rather less than the area of the Russian Empire, including Siberia and Central Asia; but if the area of the native feudatory states in India be added, amounting to 509,284 square miles, over which England exercises as great control as Russia does over much of the territory under its sway, together with that of the United Kingdom itself, 120,757 square miles, then the area of the British Empire exceeds that of the Russian Empire; and it covers within a fraction of one-sixth of the whole land area of the globe. The recently absorbed territory of the ex-King Thebaw is not included in this epitome.

Two new prizes have been added to those which the Geographical Society of Paris is now in a position to award. One is that of M. J. B. Morot, who bequeathed a sum of 2,000 francs, the interest of which is to be given annually to the French navigator or traveller who should in the course of the year have approached nearest to the North Pole; and the other that of M. Felix Fournier, who left 50,000 francs to found an annual prize "with the object of rewarding the best geographical work, either maps or books, published during the year." While the former will hardly be considered a special incentive to braving the hardships of Arctic travel, the latter will undoubtedly stimulate to extra effort.

The war ministers of France, Germany, and Italy have recently been attentively examining geographical maps in relief, constructed on a system of which M. de Mendouca, a Portuguese councilor of state, president of the Banco Lusitano, possesses the patent and is the promulgator. These relief maps are stated to combine the advantages generally admitted to be possessed by relief maps and the convenience and accuracy of maps on flat surfaces. This new method rapidly produces by a chemical and mechanical process plane maps with the curves and altitudes in relief, so represented as to correspond absolutely with the elevations established by accurate observations. These maps are drawn on comparatively thin paper; can be rolled up and placed in the narrowest case, so that they are very light and portable, and are not injured by water.

The editor of *Science*, under date of December 4, 1885, called attention to a curious instance of persistency of error in map-making. Many years ago an army expedition traversed the White River region of Colorado, going from Fort Bridger, Wyoming, to old Fort Massachusetts, Colorado. In this neighborhood are "bad lands," eroded into curious forms, which naturally suggest a ruined city; the commander of the expedition gave the locality the name of *Goblin* City, which name appeared on his map. The map-makers, in their haste to fill up the blanks in this unsettled region, jumped to the conclusion that this was a veritable settlement, and gave it a place on their maps—a place which it has ever since retained. Not only have the commercial map-makers, almost without exception, fallen into this error, but such authorities as the United States Engineer Office and General Land Office have adopted it. The name has however been gradually changed from Goblin to Goldin, and thence to Golden City; while more than one enterprising map-maker—reasoning probably that a *city* cannot exist without means of communicating with other settlements, has constructed on paper a road down the White River to it. It is scarcely necessary to add that there is not and never was a city in this neighborhood. Continuing his very apposite comments on careless map-making, the same editor, in a more recent issue, is inclined to think that if demand begets supply, there must be a very limited demand for *good* maps in this country. And any geographer who has had occasion to use trade maps of comparatively new regions must frequently have been sadly embarrassed by the apparent carelessness in compiling them.

Heinrich Entz and August Mer have recently independently studied the voyage of Hanno, the Carthaginian. Both agree that its termination was at the island of Fernando Po, in the Bight of Biafra, called by Hanno the Isle of Gorillas. The colony of Thymaterion is identified by them, as by most authors, with the town of Mazaghan, and the promontory of Soloé with Cape Cantin. The river Lixus is regarded by Mer as the Senegal, for weighty reasons, though Entz and others have favored the Wadi Draa, much farther south Hanno's is
was probably Goree, and his Western Horn (or Bay) was

Benin. Much weight attaches to the opinion of M. Mer, who is a retired naval officer of forty years' experience, including three years of cruising between the equator and Gibraltar, on the west coast of Africa.

A catalogue of the printed maps, plans, and charts in the British Museum has been prepared by Professor Douglas, and will be issued in two large volumes.

AFRICA.

F. S. Arnot has sent to the Royal Geographical Society a sketch map of his route from Shoshong to Bihé. He followed the Zambesi from his point of crossing, a little above Victoria Falls, to Lialui, from which he proceeded west-northwest to the great plateau on which Bihé is situated.

The route from Benguela to the mission village of Bihé has been approximately surveyed by the Rev. William E. Fay. The sketch maps cover an area 60 miles wide, extending over four degrees of longitude. The first human habitations met with are at the eastern foot of the coast range.

According to J. M. Cook, who has recently returned from Dongola, it appears that the cataracts of the Nile are not correctly placed upon the map. The so-called third cataract at Hannek is no cataract at all, only a very small rapid. Between the second and so-called third cataract four or five cataracts occur, and these explain the delay in the concentration of the British troops at Dongola. From Sarras to Sakarmatta (74 miles) the rise was 450 feet.

The map of Africa, on a scale of 27 geographical miles to the inch, in course of publication by the French Dépot de la Guerre, will consist of sixty sheets. Twenty-four of these have been published, 18 of West and Central Africa, 6 of South Africa and Cape Colony. Sheet number 9 shows the Canaries and the sterile country called by Dr. Barth "Tiris el Ferar," or the country of deep wells. Sheet No. 10 gives the western half of the Sahara, and shows the routes of travellers, with many notes on the inhabitants, nature of the country, and position of the oases and wells; and Sheet No. 11 has a portion of the Ahaggar region, of which little is really known, and the better-known Terab oasis.

M. Giraud has finally been compelled to desist from his attempted explorations. His men deserted him, retaining the French flag and Chassepôt rifles, and turned highwaymen on their way back to Zanzibar, where they were cast into prison by the French consul.

The results of Dr. von Wilhelm Joest's circumnavigation of Africa are of ethnographic rather than geographic interest, since he scarcely left the coast at all, and when he did penetrate into the interior it was in such well-known places as the Orange Free State and Zululand. Still, what he did was well done, and several advantageous map corrections can be made from his notes.

A work of interest to the philologist, geographer, and anthropologist is that of l'Abbé Pierre Bouche on the Slave Coast and Dahomey.

The African travellers Juncken and Casati have arrived at Lado, an Egyptian military station on the Bahr-el-Jebel. They were exploring the Nyam-Nyam district, between the tributaries of the Nile and the Upper Congo, and as nothing had been heard of them for a long time, it was feared the Mahdi had cut off their retreat.

Mr. Henry E. O'Neill has taken great pains to ascertain the longitude of Blantyre, and his results have been accepted by the Royal Geographical Society. After careful computation, and making choice of such observations as from their nature were best calculated to eliminate possible errors of observation, the longitude of Blantyre has been fixed at 35° 3′ 34″ east of Greenwich, thus differing 7′ 24″ from the previously accepted position, which was 34° 56′ 30″ east. Blantyre is now reckoned as a secondary meridian. Mr. O'Neill on his journey from Quillimane to Blantyre availed himself of the opportunity afforded by an enforced delay on the banks of the Zambesi to study the action of that river. He is led to speculate on the probable change in the physical and political geography of that part of Africa which will result from a continuation of the wearing away of the banks of the Zambesi; for if a permanent connection be established between the Zambesi and Quaqua, and a large proportion of the volume of water now carried to the sea by the Kongone River and other smaller branches to the southward enters the Quillimane River, the effect will undoubtedly be to block the southerly channels by the precipitation nearer shore of the earth particles carried down by the river. And on the other hand the Quillimane River would be deepened by the greater "scouring" force of the larger volume of water carried down by it. The connection mentioned is now made intermittently over the low flat country between the Zambesi and Quaqua at high water. Mr. O'Neill draws attention to the neglected port of Nakala, in Fernao Veloso Bay, north of Mozambique. It has numerous good anchorages, and offers magnificent conditions for the founding of a colony. Nakala is a deep inlet forming a southern prolongation of Fernao Veloso Bay.

M. Coillard, accompanied by M. Middleton, has accomplished his journey up the valley of the Zambesi to visit Akufuna, the King of the Ba-rotse, and has been received with great kindness. The authority of the King is not very great; his minister Mataga appears to be master of everything, but he has had several rebellions to put down.

In the July portion of Petermann's *Mittheilungen*, Professor Ratzel seeks to show how misleading it is to color the map of Africa with definite political boundaries. His paper is accompanied by a double map of Africa. In one part the continent is colored according to the prevailing occupation, in the second according to the people who form states.

For the purpose of gaining information for France as to what was occurring in the vicinity of her Algerine possessions, M. Charles de Foucauld accomplished a most remarkable journey of exploration in

Morocco during 1883 and 1884. Having renounced his future prospects in the military career, he disguised himself in the costume of a Jew, in spite of the antipathy of the natives to persons of that religion. This particular disguise enabled him to conceal his barometer and sextant and make his observations under the long veil with which the Jew covers himself during prayer. Deprived of all comforts, without servants, without an animal upon which to ride, without tent or bed, and almost without baggage, he travelled and worked during eleven months among these people who had more than once before unmasked similar attempts and inflicted upon the unfortunate individual the punishment which the crime appeared to them to deserve, viz, death. To the 7,600 miles of road marked out with but few determinations of latitude and still fewer points of longitude, which cartographers had at their disposal in 1883, M. de Foucauld added 1,400 miles of new ground besides revising and perfecting in the course of his journey the work of his predecessors. His travels occupied from the 20th of June, 1883, to the 23d of May, 1884. He traversed the great Atlas range at several new points, of which he had determined the altitude, besides having journeyed for 185 miles along the base of the range, rectifying and simplifying by fresh information the orography of the country. Thanks to him, we now know that from 31 miles on the north and 103 miles on the south this commanding range is flanked by parallel lines of elevation, which, as far as our maps were concerned, is quite a revelation. We learn from M. de Foucauld that there is in the north a chain of mountains about 185 miles in length, which bears the names of Djebel-Aït-Seri and Djebel-Beni-Uaghaïn. In the south there is, first of all, the Little Atlas (the Anti-Atlas on the map of Lenz), and still farther south the strange outline of the Djebel-Bani range, the name of which we know from the Rabbi Mardochée, and which Lenz crossed, but without identifying it. This journey, extending over five days to the south of Meknâs, was accomplished by M. de Foucauld in the midst of warlike peoples and marauding tribes. In the month of December, 1883, the traveller touched the Uâdi Dhrâ'a to the south of Tattas. "This river," he says, "the bed of which is nearly 2½ miles in breadth, is absolutely dry, except during the melting of the snow and the seasons of continuous rain." Later on he again saw the river farther to the northeast, in the district of Mezquita, "where this same river, broad and with uninterrupted stream, flows through plantations of date palms." The itinerary of M. de Foucauld places that part of the course of the Uâdi Dhrâ'a, as indicated on Dr. Rohlf's map, quite one degree farther west. This important correction should be utilized to revise the itinerary of the German traveller. Finally, the accurate information obtained literally revolutionizes our previous geographical and political knowledge of Morocco.

The death of King Mtesa is confirmed, but it is believed that his son will prove more friendly to civilization than the father. Miramba is also dead.

Dr. A. Fischer's brochure, *Mehr Licht im dunkeln Weltteil*, reviewed in the November issue of the Proceedings of the Royal Geographical Society, contains a large amount of statistical information, through the midst of which much valuable geographical knowledge is interwoven.

Lieut. Victor Giraud, of the French navy, has given us (see Proceedings Royal Geographical Society, September) a delineation of Lake Bangweolo, which differs widely from that first published by Dr. Livingston, as a comparison of his sketch with the society's map of Eastern Equatorial Africa will show. We are indebted to the same officer for having traced the Luapula from where it issues from the lake, as far as Moero Mkata. Equally interesting is the information brought home by Herr Reichard from the copper country of Katanga and the Kingdom of Msiri, regions hitherto known to us only from the vague reports of Portuguese traders or natives. Lieutenant Giraud left Daro-es-Satam on the 19th of December, 1882. Crossing in succession U-zaramo, Khutu, U-sagara, U-hehe, U-bena, and the Livingston Mountains, by routes differing in many places from those followed by his predecessors, he reached the northern extremity of Lake Nyassa, and thence ascended to Kiwanda on the "Stevenson road." He then turned off toward the southwest and travelling over a wide plain, entered U-emba, the country of B-emba, whose chief is Kitim Kuru, by far the most powerful ruler whom the explorer met with. On reaching Zapana, Lieutenant Giraud sent his caravan on to Kazembe's town, whilst proceeding himself to the shores of Lake Bangweolo. The lake, according to this explorer, consists of a sheet of open water in the north, apparently nowhere more than 20 feet in depth, and of a vast swamp. Kisi, the most elevated island, only rises to a height of 80 feet. The Luapula leaves the lake at Kawende Point. The river there is about 300 feet wide and 15 feet deep, its course being well defined between walls of gigantic rushes. After about a fortnight spent on the river and in forcing his way through a lagoon at the back of it, Lieutenant Giraud's progress was stopped by an "army" sent against him by Mere-Mere, chief of Ba-ussi. He was compelled to surrender; but after remaining a prisoner for some time he succeeded in escaping, made his way through the country of the hostile Wa-Kisinga, and following the Luapula for some distance, he at length rejoined his caravan in Kazembe's town. Eventually he reached Iende on the Taganyika.

Dr. Böhm and Herr Reichard left the Belgian station of Mpala, on the Tanganyika, on the 1st of September, 1883, and on September 27 they reached the Luapula, where that river is 500 feet wide, but not navigable, owing to rapids. They crossed into the kingdom of a powerful chief, named Msiri, who subjected them to vexatious annoyances, and prevented their progress until at last Dr. Böhm died on March 27, 1884, after ten days' suffering. Soon afterward Herr Reichard was permitted to start for Katanga, which he reached on May 27, and visited the two copper mines, which he found to be exceedingly rich. His attempt to trace the Lufira to its source was frustrated by the hostile attitude of the Wa-ramba, and he was compelled to turn back on June 2, when within a few days only of his goal. Owing to the hostile attitude of Msiri, and the annoyance consequent thereon, the valuable collections made by Dr. Böhm had to be abandoned. On November 6, 1884, the Luapula was crossed once more, and after another long march through a hostile country the hospitable station of Mpala was reached again on November 30, 1884. According to Herr Reichard the Lualaba is the real head-stream of the Congo. Where he saw that river, a short distance above the Upembe Lake, it is 1,000 to 1,500 feet wide, and the natives assert that it can be navigated as far as Manymma. The Luapula, on the other hand, has a width of only 500 feet, and forms numerous rapids in its course through the Mitumba Mountains. The Lufira, where crossed, was only 150 to 200 feet wide. It forms two waterfalls, one in the salt plain of Muacha, and another, Juo, at the head of the gorge through the Viano Mountains. The Juo falls are 80 feet high, the breadth of the river being 330 feet.

The two Portuguese explorers, Captain Capello and Commander Ivens, who started last year upon an expedition across Africa, eventually reached Cape Town after a most adventurous journey. They subsequently left for Mossamedes, and returned to Europe via the Congo. They reached Lisbon on the 17th of September, where they were received by the King, and welcomed by an enthusiastic demonstration of their countrymen. They have traversed a region which no European had ever set foot in. Leaving Mossamedes in March, 1884, with an escort of one hundred and twenty men recruited along the coast between that place and St. Paul de Loando, they reached Quillimane, upon the eastern coast, to the south of Mozambique, in May, 1885, after having discovered the watershed whence the rivers of Central Africa flow north and east towards the sea. They travelled over 4,500 miles of territory, 3,000 miles of which were previously unexplored, and they are said to have discovered the sources of the Lualaba, an affluent of the Congo (which has been so frequently referred to in recent geographical discussions), as well as those of the Luapula and Chambeze, the upper waters of the Congo. They also visited the copper region of the Yaranganga district, situated between the Lualaba and the Luapula Rivers. Messrs. Capello and Ivens found the tse-tse fly very abundant; sixteen of the party died from their bites, without counting cattle and hunting dogs. They lost, all told, sixty-two men in fifteen months, and were almost exhausted when they reached Feté. (See Proceedings of Royal Geographical Society, December, 1885.)

Mr. J. T. Last left England on the 2d of September, on his way to Zanzibar, where he will equip his party for the expedition in which he is engaged under the auspices of the Royal Geographical Society. He will proceed to the confluence of the Rovuma and Lujendi Rivers, fix the longitude of the junction, and will then establish himself awhile in the Namuli Hills. After a study of that region, Mr. Last will enter the valley of the Likuga, follow it to the coast, and then follow the coast to Quillimane or Angoche.

In a report to the British foreign office, by Mr. Laurence Goodrich, Her Britannic Majesty's acting consul for the Nyasse district, dated Bandawé, Lake Nyassa, June 1, 1885, he describes a recent visit to the country on the west of the lake. He refers principally to the territory of Muazi, which was visited by Livingston. During his stay at Kasungo, Muazi's town, 130 miles SSW. of Bandawé, the chief died and was succeeded by his nephew Katamé. Mr. Goodrich was well received there, the natives having that respect for the English which is always to be found where Livingston has been the only previous white visitor. The chief object of the visit was to inquire into and endeavor to wean the chiefs from encouraging the slave trade. The country he passed through between Bandawé and Kasungo he found entirely uninhabited, though abounding in game of all kinds. Kasungo is situated in the center of a large treeless plain, 2,258 feet above the level of Lake Nyassa, the houses being built around a curious conical-shaped hill 900 feet above the plain. The chiefs interviewed were anxious to see English traders settled in the country. Muazi's country is known as the Marumba country, and the people are Wanyasse. Here a very large stock of ivory is to be bought—according to Mr. Goodrich, Katamé offered to sell him a hundred tusks. The soil (he states) is good, and adapted for wheat growing; cattle thrive admirably, and the tse-tse fly does not exist in the district. The plain around the base of Mount Kasungo is 4,000 feet above the sea, which altitude should insure a climate suited to Europeans. The natives appear to be simple and peace-loving.

Dr. Hannington, Bishop of Equatorial Africa, started with Mr. Taylor early in June to explore a route, different from that followed by Mr. Joseph Thomson, via Chagga and the Massai country to the eastern shores of Victoria Nyanza. He is of the opinion that if this route be once opened all the caravans for Mombasa to the interior would adopt it, and there would be a great saving of time and distance. The bishop has attached himself to a Swahali caravan. He hopes to touch Lake Naivasha and emerge at Sendega in Lower Kavirondo. When last heard from he was working his way through the unknown region between Kilima-njaro and Victoria Nyanza, and hoped to be at Rubaga by the end of the year. Since then an unconfirmed rumor has been received to the effect that he had been taken a prisoner by the King of the Mobanza, (?) who threatened to put him to death. If successful, the bishop will accomplish a work of great geographic as well as humanitarian value. Sir John Kirk was consulted, and approved of the scheme.

Dr. Oscar Lenz's work on *Timbuktu* appeared early in the year. Since then the Imperial Geographical Society of Vienna has received good news from the doctor's present African exploring expedition, which had passed through Monrovia, the capital of Liberia, and gone on to the Cameroons, the ultimate object being to explore the watershed between the Nile and Congo from the west.

M. Leon Guiral has sent to the Geographical Society at Paris a description of the west coast of Africa, about the mouths of the San Benito or Eyo and the Dote, 7½ miles farther south. The Eyo is a mile in width at its mouth. Banks of rocks bar the entrance, but the left arm is navigable for vessels drawing two meters of water. The banks are marshy. M. Guiral ascended it about 30 kilometers to Iniger, where there are falls. It has several tributaries, some of them navigable for canoes. The Dote is a river of little importance, with marshy banks, and is about a meter deep and 40 meters wide along the lower part of its course. It can be ascended in a canoe for about 21 miles. The commerce of the district concentrates in the village on the right bank from which it takes its name. (See Proceedings of Royal Geographical Society, December, 1885.)

In the Proceedings of the Royal Geographical Society for February, 1885, is a long and learned article upon "European Territorial Claims on the Coast of the Red Sea and its Southern Approaches," by Sir R. W. Rawson, than whom, perhaps, no one is better fitted to discuss this subject, which is of great historical as well as geographical importance.

Mr. E. H. Richards, an American missionary, has journeyed from Inhambane to the Limpopo, through a region which is at present a blank on our maps. The Bombom River forms the western boundary of the Portuguese province, and drains a large area of western Inhambane, as well as the eastern slope of the Makwakwa Ridge to the west. The country west of this ridge is semi-deserted, in consequence of the raids of Umzila's soldiers. From the Makwakwa Ridge to the Limpopo is level land. The Ama-gwaza, or people of Umzila, inhabit or control the country from the Zambesi to the Limpopo, and with the exception of the Portuguese possessions of Chiluan and Inhambane, from the sea in the east to the Matabele country on the west. In a second journey Mr. Richards, besides visiting a large and hitherto untravelled area, was successful in reaching Baleni. He left Delagoa Bay on foot, attended only by a Zulu convert and three porters. The Komati River, 200 yards wide, 30 feet deep, was crossed in a "dugout" canoe, and its course followed for several days; the river was then left and a series of thirteen lakes passed. Though there was no connecting stream at that season, the natives call this string of lakes the Liputa River, but there are often hills and bushy districts between the lakes. Emerging from the bush close to the Limpopo River, they found themselves at Baleni. Herds of cattle were visible in every direction and clusters of small huts were very numerous. Manjobo or Manjova, the ruling chief, has several kraals on the west and one on the east side of the river, which here runs through a low flat plain of indurated alluvium as hard as marble. The river banks are about two yards high, the stream being about 15 feet deep and 200 yards wide. Manjobo's kraal on the east side is called Emkontweni, "the place where the spear is stuck in the ground." The kraal of the Chobbas, or Machappas, is on the Limpopo, about 12 miles north of the Shangan River, which enters the former from the eastward, and is otherwise known as the Luize or Mitti River. From a hill just eastward of the Shangan, the plain of Baleni could be seen extending NW. and SE. as far as the eye could reach, and about 25 miles in width. In the rainy season the plain is an immense pool or lake, and all the kraals are deserted for several months. The Shangan is salt, but good water can be had by digging. The people call themselves Ama Shangani, and all adults speak more or less Zulu, which is the language of the "court." Thence to Inhambane, took nine days through a most populous country. Bingwana, a kraal of about 5,000 inhabitants, is about four days from Inhambane, on the river of the same name, a deep but narrow stream abounding in sea-cows. The route was considerably south of the one taken in 1884.

The Dutch exploring expedition into Portuguese West Africa has been so unfortunate as to lose its leader, young Mr. D. D. Veth, who died from disease on May 19, 1885, in camp on the banks of the Kala-Kanga River, between Benguella and Humpata.

In the October number of Petermann's *Mittheilungen*, is the first part of an account of the journey of the Austrian explorers, Drs. Paulitschke and von Hardegger, to Harar, by the former. It is accompanied by a map of the districts traversed. The concluding papers appear in the December number, in which will also be found an account and map of Menge's second journey in Somali-land.

A fresh expedition in Somali-land has been undertaken by F. L. and W. D. James, who write from Berbera that they intend to traverse the Habr Gerhajis' country to Lebiholii, whence five days over the desert will bring them to Ogaden.

The chief geographical societies in Germany have resolved to erect a monument to the late Dr. Nachtigal, who died April 24, on board the German gunboat "Möwe", off the west coast of Africa, on Cape Palmas, where he lies buried. It is intended to have it so large that it will serve as a landmark to seamen.

The work done by Lieutenant Wissmann, in his exploration of the Kassai River, the great southern tributary of the Congo, is second in importance only to the discovery of the Congo itself. It will seriously modify the conjectural geography of that portion of Africa. He found the river to be of immense volume, and navigable from its junction with the Lulua. He found the Sankuru and the Lubilash to be one river which instead of flowing northward to the Congo, turns westward and joins the Kassai. As it approaches the Congo the Kassai receives the great Koango, and enters the main river by the Kwamouth, after receiving the water of Lake Leopold. Thus the river which on Stanley's last map joins the Congo west of Stanley Falls, cannot be the Lubilash, and moreover must be of no great length. This discovery of Lieutenant Wissmann, along with that of the Mobangi by Mr. Grenfell, greatly increases the navigable waterway of the Congo system.

Besides much good detail work done by the Rev. G. Grenfell on the Congo, he with Rev. T. J. Comber, has recently explored the Mobangi, which enters the right bank of the Congo, forming a great delta, between 26′ and 42′ south latitude, nearly opposite Equator Station, and is probably its greatest tributary. Mr. Grenfell ascended the Mobangi on a mean course of north by east from the equator to 4° 30′ north latitude, and left it still an open waterway. At 4° 23′ north, just below the second rapids, he found it 673 yards wide; at no point lower was it less in width. Its mean depth is 25 feet, and its current not more than 80 to 100 feet per minute. From Mr. Grenfell's notes it would seem that this river is navigable the whole way from the Congo to 4° 30′ north, a distance of probably 400 to 450 miles, taking account of the bends. His opinion and that of his Congo colleagues seems to be that the Mobangi is probably the lower part of the Welle, a river whose course is one of the unsolved problems of African geography; but this opinion is scarcely sustained by the knowledge we now have of the region. Arguing from analogy, we should conclude that the source of the Mobangi does not lie east of 20° east longitude, and applying the measurements to Stanley's map, the watershed falls just on the line thereon suggested. The distance in a direct line from the ultimate point reached by Mr. Grenfell to the last-known point on the Welle is 540 miles, and to the source of the Welle some 900 miles. It appears then to be practically impossible for this river (of less than the third of a mile in width), to carry off the water of the Welle Basin; and Mr. Stanley's suggestion, that the Bujere (wrongly called the Aruwimi) is the outlet of the Welle is rather strengthened than otherwise by this latest, and certainly not least important, contribution to our knowledge of the mighty Congo.

The Portuguese possess a tract of land on the northern bank of the Congo, extending from Cape Lembo, south of Kabinda Bay, to Massabé, and extending inland 30 or 40 miles so as to contain Kabinda, Molembo, Landana, and Massabé.

The whole of the valley of the Kwilu, where the International Association had eighteen stations, is ceded to France. M. de Brazza, recently returned from Africa, reports most satisfactorily from the French Possessions on the Congo; his reports are so late as October 13, 1885.

The limits of the new "Kingdom of the Congo," as recognized by the Berlin Conference, appear to be as follows: On the Atlantic seaboard, from Banana point to Gabé (5° 45′ south latitude), then by one parallel of Gabé to the meridian of Ponta da Lenha, by this meridian north to the Chiloango, thence to the source of that river, thence to the Mtomba-Mataca falls of the Congo, leaving to the French the station of Mboco, but reserving Mucumbi and Manyanga, thence along the Congo to its confluence with the Bamba beyond the equator, where the boundary running northwest remains to be determined. The southern frontier follows the Congo from Banana to a point a little above Nokki, the south bank belonging to Portugal, thence on the parallel of Nokki to the Koango, along this river to about 9° south latitude, and thence in a diagonal line across the continent to Lake Bangweolo. Eastward the boundary coincides with the west coasts of Lakes Bangweolo, Tanganyika, Muta-Nzighe, and Albert Nyanza. Within these limits the new state will have an approximate area of 1,000,000 square miles, and a population of probably 40,000,000, mostly of Bantu speech and Negro or Negroid stock.

The council of the Royal Geographical Society, at its meeting of June 22, unanimously passed a vote of congratulation to the King of the Belgians on the success which has attended his work of exploration and civilization in tropical Africa. The resolution was as follows: "That the thanks of the council be conveyed to King Leopold II, the King of the Belgians, for the interest taken by His Majesty in the exploration of Africa, and respectful congratulations on the signal success which has attended the schemes promoted by His Majesty's wisdom and munificence." In acknowledging this communication officially, His Majesty expressed his great satisfaction at knowing that his efforts to introduce civilization into the heart of Africa are appreciated by such high and competent authority.

Bulletin No. 3, 1885, of the Royal Geographical Society of Belgium, contains a paper by the secretary on the Congo question, describing the explorations made in the basin between 1485 and 1877, the foundation of the International Association, the creation of the Free State, and finally a description of the basin.

Volume VIII, No. 2, of the *Geographische Blätter*, published by the Bremen Geographical Society, contains a similar paper by Dr. Oppel, dealing with the scientific and economical importance of this district. The paper is divided into two main sections: (1) The discovery and investigation of the Congo (*a*) between 1484 and 1872, (*b*) the systematic exploration since 1872; (2) the extent and boundaries, geology, &c., of the Congo region. While surprisingly alike in general features, these two papers are by no means coincident, since both show independent thought and preparation, and indeed treat the same subject from quite different standpoints.

Science for August 23, 1885, contains an excellent map of the Congo Basin, reproduced by permission of Harper & Brothers.

Among the recent scientific missions ordered by the French minister of public instruction is that under Lieutenant Palat, to explore the route from Senegal to Algeria by Medina, Timbuctoo, Mabrouk, and the Touat.

Spain has recently acquired considerable territory in Africa, comprising the west coast of the Sahara between Cape Bogodor (20° 9′ north) and Cape Blanco (20° 45′ north), both included; and in the Gulf of Guinea, the coast line from the Muni River, which forms the northern boundary of the French possessions on the Gaboon, to the Rio Compo (0° 43′ to 2° 41′ north). Six stations have already been established on the Sahara coast, and all points giving access to shipping will be permanently occupied. Old treaties with the chiefs on the Rio Benito have been renewed, with a view to prevent the threatened advance of the French in that direction.

The conductor of the Cartographic Institute, Hamburg, Herr L. Friedrichsen, writes thus concerning the limits of the German possessions in West Africa: "The Mahin district, on the Gulf of Benin, between Lagos and the mouth of the Niger, settled by the Hamburg firm of G. L. Gaiser, has not yet been placed under German protection. The coast from Jaboo to Old Calabar will, in my opinion, be in future regarded as under British protection, but has not hitherto been officially placed under any European power. The frontier of the German Cameroon begins with the Ethiopian cataract on the Great River, lying from there in a southwesterly direction to the sources of the Rio del Rey, following the right bank of this river to the coast, then the coast line in a southeasterly direction to the river Behuwe, excluding the town and neighborhood of Victoria as British, as well as the island of Malimba. The latter, as well as the whole coast from the river Behuwe to Gumbegumbe, is not described by me in the commissions of foreign officials as without a ruler, but as a tract on which the actual raising of the German flag is yet the subject of diplomatic treaty. The German protectorate in Southwest Africa begins with 18° south latitude, not with Cape Frio."

Dr. Ballay, in an address on the new possessions of France in Africa, sums up by saying that while the Ogowé can never be rendered navigable, it can at least be made useful for bateaux. Its basin is naturally fertile and rich in resources. On the other hand, the country extending from this basin to the Congo is generally sterile. There is little to hope for from this region, but it is the beginning of the practicable route for reaching the trade of the upper region, which has inhabitants of intelligence and thrift. The protectorate of France now extends along the whole north coast of the Gulf of Tadjura as far as Bahr-Aseal, and M. Caspari states that the relations of France with the Danakils are cordial. Obock is at least a safe and easily accessible harbor, and the abundance of water renders possible the cultivation of vegetables.

The fifth expedition of the Belgian International African Association, which started with a view of connecting by a chain of stations the east coast with the interior basin, has returned, the expense proving too great to render the project profitable. The efforts of the association at present will probably be confined to the Congo watershed.

Some Swedish merchants have purchased in the Massanja country, in the Cameroons, some 20 square miles of land, on which the Swedish flag was hoisted with proper honors some months ago. They state that had they been so empowered by the Swedish Government, on landing two years ago, they could have taken possession of the country from Boto, near Victoria, to Rio del Rey, one of the richest tracts of land on the west coast of Africa. At present they trade at their own risk.

The Swedish Society of Anthropology and Geography has commissioned Baron Schwerin, professor of geography at the University of Lund, to proceed to the Congo on a scientific expedition, the chief objects being to make geographical, meteorological, botanical, and zoological studies in the new state, and to collect ethnographical objects. Barons Nordenskjöld and Dickson have lent the expedition a number of valuable instruments.

The *Bulletin* of the Italian Geographical Society for September contains extracts from the unpublished journals of Pellegrino Matteucci, the African traveller. These have been edited by Della Vedova, and are illustrated by a map showing the itinerary, and also the routes of Nachtigal and Rohlfs. Matteucci's journey, one of the most remarkable on record, extending from the Red Sea at Suakim to Lake Chad, and thence to the Niger and the Gulf of Guinea, has hardly attracted the attention it deserves, chiefly perhaps on account of the early death of this promising and brilliant explorer.

The roll of geographical journals is increased by one. The Florentine section of the Italian African Society has been authorized by the central council and treasurer to issue a bulletin. It is intended to be partly eclectic, presenting geographical and especially African news to its readers, and to be particularly the official record of the proceedings of the section.

ASIA.

At the June meeting of the Geographical Society of Paris, Baron Benoist-Méchin described a recent journey in the Merv oasis. This was a continuation of previous communications to the society of the great journey made by the baron and some companions from Peking, through Kirin to Ninguto, and thence along the Tiumen to Vladivostock. The journey the whole way was along the Corean frontier. From Vladivostock the travellers proceeded to Tomsk, thence to Samarkand, through Karshi to Bokhara, to the Amou-Darya at Charjni, down that river to Petro-Alexandrovsk, thence to Khiva, and lastly across the Kara-Kum to Mero, Sarakho, and Meshed. The detailed narrative (with maps) is given in the bulletin of the society. At the same meeting M. de Saint-Pol-Lias presented a map of the upper course of the Red River, prepared by the Anamites. Another map of importance is that of the navigable water-ways of Southern India-China, prepared by M. Rueff, who has established a company for navigating those waters.

Herr Glaser, the Arabian traveller, has returned to Arabia to resume his explorations. This second journey is to be mainly geographical, but archæology will also receive attention. Besides visits to Marib and Nejdran, Herr Glaser contemplates a long journey through the interior from Hadramant to Omaun, and a second across South Arabia.

In *Science*, July 3, 1885, is an excellent epitome of an article on "Routes into the interior of Western China," which originally appeared in *Science et Nature.* The two Chinese rivers (Sikiang, or Canton River, and Song Ka) must for the present be considered as impracticable for commercial purposes, not precisely on account of the natural obstacles to be overcome, but because for a long time the Celestial Empire will be more or less impenetrable and dangerous for Europeans: and, on the other hand, the course of the Me-Kong is too long and too hilly. The routes which traverse the bed of the Brahmapootra and the valley of the Irrawaddi present almost insuperable difficulties. The route of the Salmen is most attractive, but it should not be forgotten that besides its length it must cross two water sheds, one of which at least is very difficult, and must ascend the Me-Kong for a very long distance. The route by the Red River remains: this is not particularly accessible; but to establish communication with Yunnan and Szchuen some obstacles must be surmounted, and this is the course which offers fewest of them.

Mr. Holt S. Hallett has finished his reconnaissance for railway routes in India-China, and the narrative of his journey, while not furnishing anything absolutely new, serves to enlarge our knowledge of the geography of that interesting region.

The chief paper in the May issue of the Proceedings of the Royal Geographical Society is upon the disputed question of the sources of the Irrawaddi. As no one has yet followed the Sanpo from Thibet downward, it is still unproved whether it enters the Irrawaddi or the Brahmapootra. Mr. Robert Gordon opposes the commonly received idea by advocating the Irrawaddi view, and gives six substantial reasons for his belief. General J. T. Walker, differing from Mr. Gordon, attacked the weakest point in his paper, that in which he thinks that the Zayul Chu may prove to be an affluent of the Irrawaddi.

Colonel Woodthorpe has just completed a journey through the Singpho, or Sanpo country. He penetrated into the land of the Borkhamptis, on the Northern Irrawaddi, where no traveller is believed to have been since Lieutenant Wilcox's tour in 1828. The Irrawaddi is unnavigable at Pedan.

A writer who has just travelled widely through Tonquin and Southern China describes in a recent number of the *République Française* the route from Lao-Kai, on the Red River, to Meng-tsze in Yunnan. Premising that the river from the mouth to Lao-Kai on the Tonquin border is tolerably well known, he refers to the various routes for getting into Southwestern China, but is far from enthusiastic about any of them, although he thinks that France in Tonquin has as much chance of getting the China trade as any of her rivals in the south. The writer then describes the route along the river from Lao-Kai to Manhao, the head of the Red River navigation. From this point the road to the plateau of Yunnan is said to be mountainous and difficult in the extreme. The article is of special value at this time, when the commercial geography of Southeastern Asia promises so much of importance.

The journeys of Dr. Neis in Central Taos (more than 3,000 miles) have resulted in a vast amount of information regarding the commercial routes of the western basin of the Me-Kong, the anthropology and ethnology of the Laos and the Khas, and the social, commercial, and political condition of the regions visited.

In a recent consular report from Siam, Mr. Archer gives an account of his journey into the province of Kabin, which lies on the eastern side of the Siamese delta, at the foot of the mountains separating the Mimam Valley from the Me-Kong. He gives some very interesting notes on the little-known Laos.

The Government of India has conferred the title of Raj Bahadoor and a grant in perpetuity of a rent-free village in Oude on Pundit Kishen Singh Milwal, an employé of the survey department, who is well known to all geographers for his explorations in Thibet, which have been published over the initials "A. K."

Colonels Lockhart and Woodthorpe have been sent with a party to Gilghit, and it is intended that full surveys of the region lying to the northwest of Kashmir shall be executed. Several passes of no great difficulty lead toward the Russian possessions, which here approach British India closely. This mission is expected to largely increase our knowledge of the country toward the upper waters of the Oxus. Danileff, in examining this river, has found what he reports to be the point of its ancient bifurcation into the Amu Daria and the Uzboi.

Sir Henry Rawlinson has added considerable to our knowledge of the Badghis district, in Northern Afghanistan, north of the watershed of the Herat Valley. The September issue of the Proceedings of the Royal Geographical Society contains a map of the territory about the Hari-Rud and Murghab Rivers, including the Badghis—the district the possession of which is now in dispute between Russia on the one hand, and Afghanistan and England on the other. The *American Naturalist* for December, 1885, contains an interesting account of this section, and a concise history of the Carolines.

Up to July, 1885, the Afghan Frontier Commission had worked through districts already explored more or less in recent times, either by the Russians or others. Since then comparatively new ground has been broken, from which much of great geographical interest may be confidently expected. One very important matter has been accomplished, *i. e.*, the exact determination by Captain Gore of the longitude of the great dome at Mashhad, longitude 59° 35′ 52″. 3, latitude 36° 17′ 42″. The result shows an apparent error of only eleven seconds in longitude at the end of a long line of more than 1,000 miles of survey from India. Captain Talbst has started to carry on triangulation to the head of

Hari-Rud, with permission to proceed as far as Daulatyar. A native surveyor has started southward across the many apparently parallel ranges (quite unlike anything shown at present on our maps) between the Upper Hari-Rud and Gaur, or Zarni. Another native surveyor has started for the Upper Murghab and Ferozkohi country to survey the direct routes to Mannana from Obeh, across the Band-i-Turkestan.

Lieut. Col. H. C. B. Tanner, S. C., deputy-superintendent of the survey of India, in charge of Darjeeling and Nepaul boundary surveys, makes some exceedingly interesting communications on the Himalayan snow peaks.

An account of M. Potanin's journey from Peking to Lang-tcheou, in 1884, was given in the Russian *Izvestia.* The country between the Yellow River and Boro-balgasun is covered with sand, rarely moving sand, but *barkhans* fortified by a growth of *shiapyk*, a species of Artemesia, with bushes of *cavagana* in the cavities between. Water is plentiful. The dry grounds between the sands are covered with steppe vegetation, and sarrazin, millet, and hemp are grown there. The Orthous inhabit this region. Boro-balgasun was once a town, but now contains only a few huts within its ruined walls. At Edjin-Khoro, on the Tchamb-Kak River, are two tents, in which the bones of Zenghis Khan are said to be preserved. After leaving Boro-balgasun, the expedition visited the salt lake Baga-Shikye and passed over an almost uninhabited region, with ruins of Mussulman villages, destroyed when the last insurrection was put down. Lin-tcheou, on the Hoang-ho, is surrounded by fruit gardens, and for 50 miles south of it numerous villages extend along a canal which runs parallel to the Hoang-ho. This richness is of recent origin, for the whole region bears traces of the desolation wrought by the Chinese after the suppression of the insurrection of which the town of Tsin-tsipou was the center. South of this town M. Potanin left the Hoang-ho and crossed the series of flat ridges, which rise from 6,000 to 7,000 feet above the sea, and are covered with loess to a thickness of 200 to 300 feet. The sandstone of these hills contains some beds of salt. The loess covers the whole country from Ping-yang-sia to Lang-tcheou, which is a great city, picturesquely built on the right bank of the Hoang-ho, at the foot of a mountain. The population is of Turkish origin, and although it has assumed Chinese customs, it keeps its Mussulman religion. The latest news from this expedition was dated San-chuan, January 25, 1885. It had gone up the Hoang-ho and eventually reached the confluence of the Tchitai with the Yellow River. M. Berezovsky had left the expedition and taken another route, via Hoy-syan. He proposes to join MM. Potanin and Skasi on their way to the south.

Colonel Prejevalsky has discovered three peaks, each over 20,000 feet high, in the middle range of the Kuen-lun. He has given them the names of Muscovite, Columbus, and Enigmatical. The most elevated point of the first named is Mount Kremlin; of the second Mount Djinri;

and of the third, the crown of Monomachus. The plateau skirting the middle Kuen-lun has an average height of 4,000 feet. It appears from a telegram from Colonel Prejevalsky, dated Osh, August 31, that this intrepid explorer has again failed to penetrate into Thibet over the Keria Mountains, in consequence of the strenuous opposition of the Chinese, who barricaded all the available highways with stones and destroyed the bridges. The *Invalide Russe* publishes the following telegram from Colonel Prejevalsky from Pishpet, but dated Karakol 2d (new style 14th) November: "Our voyage has ended happily and with most encouraging scientific results." (See Proceedings of the Royal Geographical Society for December, 1885.)

Dr. Zélandt has finished his work on the Kirgiz, which will soon be published by the West Siberian section of the Imperial Geographical Society.

A parliamentary blue book (Corea No. 3, 1885), lately published, contains the report of a journey made by Mr. Carles the vice-consul at Söul, from that place to Phyöng Kang, where some gold mines exist. The review of this in *Nature*, August 27, shows that it contains much of geographical interest.

Mr. Gardner, British consul at Newchwang, China, publishes with his annual trade report this year (China, No. 6, 1885) a most interesting account of his consular district, which embraces the whole of Manchuria. The report corrects some of the errors existing on our maps, which are far from accurate.

It is to be hoped that the many rumors of prospective activity in railway building in China may be found to be well grounded. The necessary surveys would be of incalculable service in correcting the maps of the various provinces. These maps are mainly the work of the early Jesuits, and though remarkable, when one considers the material with which they worked, are still far from what they ought to be.

Port Hamilton, of which England took possession at the time when hostilities with Russia were imminent, consists of a group of small islands about 45 miles northeast of Quelpaert and about 30 miles off the Corean coast, in the Brougham Channel, separating the peninsula from Japan. The position of the group is 34° 1′ 23″ north latitude and 127° 17′ 30″ east longitude. England has since given up her claims.

Sibiriakoff, the wealthy Russian merchant, well known as the friend and patron of Nordenskjöld, has himself made an interesting journey during the summer of 1884. The details of it have only recently been made public, as news travels slowly in those regions. He ascended the Petchora to Oraneto, then crossed the Ural to the Sigva, or Whitefish River, which joins the Sosva, an affluent of the Obi. The traveller reached Shikurik September 21, and Tobolsk October 18. It is demonstrated by this journey that a trade route by which goods can be carried in summer is practically open in this direction, a matter of great commercial importance to Siberia.

An exploration to cover a period of five years is being organized by Yadrintseff, under the auspices of the Russian Geographical Society. Its purpose is the investigation of the ethnology and social economy of Siberia; particular attention will be given to opportunities for extending and correcting geographical knowledge.

The trans-Siberian railway has already finished its first section of 135 kilometers between Ekaterinburg and Kameshoff, and its early completion to Tuimen is confidently expected. At each step in its advancement the geographical advantages to be derived from this commercial enterprise will be more marked.

Preparations are being made for the expedition under Dr. Bunge and Baron von Toll, which will start next spring for Ustyansk, for the exploration of the New Siberian Islands, which since Anjou's journeys in 1821–'23 have only been visited by the unfortunate Jeannette people for a few hours on their route to the mouth of the Lena.

The geographical effects of the Krakatoa eruption, while of great importance, are of too local a nature to be properly considered under "progress in geography."

Great Britain has annexed the territory of the ex-King Thebaw to her India possessions.

In the province of Adana, Asia Minor, not far from Tarsus, at a few hours' travel from the sea, among the mountains, has recently been discovered a ruined town hitherto entirely unknown. The ruins lie near the route from Sélef-ké to Karaman, by Mohara. Sarcophagi, almost intact, and resembling those of Lycia, exist there and would seem worthy of study.

Russian geographical exploration of the Caucasus has begun. MM. Djin and Dimick have traveled among its glaciers, climbed its passes, and given an account of their travels in Petermann's *Mittheilungen.* Ushpa is estimated at 16,500 feet high, and Tetuuld at 15,500 feet or thereabouts.

It is stated that an accurate survey of the island of Yezo and the neighboring islands (especially the Kuriles) is to be made by the Japanese naval department. It is anticipated that the work will occupy four years.

The *Zeitschrift* of the Gesellschaft für Erdkunde in Berlin (Vol. xx, No. 3) is almost wholly filled with an account by Herr Schmidt of the travels of the friar Rubruk, between 1253 and 1255, into the heart of Central Asia and to the borders of China.

EUROPE.

The lectures given under the auspices of the Geographical Society of Paris, in the spring of 1884, were so successful that they were resumed this year. The names of some of the lecturers give us an idea of the importance attached to the subject of geography in Europe: Janssen, de Lapparent, Bouquet de la Grye, Dr. Hamy, Himly, Levasseur, Louis

Simonin, Michel. It would be of the greatest benefit to this country if a society co-ordinate with the Geographical Society of Paris, having its headquarters at Washington, could arrange for a course of lectures by some of the confreres in this country of the above-named gentlemen.

Under the title of *O'Explorador* (the Explorer), a Portuguese journal commenced its appearance with the first of the year at Lisbon. It appears twice a month, and will chronicle the advance of science in all its branches, but especially that of geography and travel.

In March appeared the first number of the *Scottish Geographical Magazine*, the organ of the new Scottish Geographical Society. It aims at being much more than the organ of the society, however.

At the March meeting of the Geographical Society of Paris, Mr. Charles Rabot described the results of the mission with which he was charged by the minister of public instruction to explore Northern Finland and Russian Lapland. He explained especially the valleys of the Pasvig and Talom, as well as Lake Enara. It has hitherto always been believed that the highest mountain in Sweden was Sulitjelma, on the Norwegian frontier, in latitude 67° 16′ north, and belonging as much to Norway as to Sweden, the height of which is a little more than 6,000 feet. In 1884 the topographical surveyor of the province of Norrland found that another mountain, viz, Sarjektjåkko, 6,760 feet in Swedish Lapland, was higher than Sulitjelma; but now it has been discovered that neither is this mountain the highest in Sweden. Bucht Svenonius and Mr. Rabot state that the honor belongs to Kebnekaisse, latitude 68°, also in that province, the height of which has been ascertained to be 6,940 feet above the level of the sea. In the same neighborhood is Kaskasatjokko, 6,800 feet. The observations of Mr. Rabot in the mountainous area of Store Baergefjeld, in Nordland, Arctic Norway, represented on the best charts as occupied by an immense continuous glacier field, show that it has been wholly misunderstood. There is no primary glacier, but merely seven secondary glaciers, isolated in ravines, and hardly passing beyond the stage of névé. Rabot afterward made explorations in the Kola peninsula of Russian Finland, determining the existence of three distinct chains of mountains between the Polar and White Seas, which reach a height of more than 3,000 feet. The country has hitherto been charted as a sort of plain, broken merely by lakes and low hills. The area between the ranges is level, and trees of good size and form reach latitude 68° 50′; beyond they extend some distance, but do not exceed 12 or 15 feet in height.

In the "Elementär lärooarken" (classical schools) of Sweden, geography has hitherto been classed as an appendix to history, and at the "Lektor" (candidate) examinations in history and geography, questions are only asked about the former. At the congress of teachers held in Stockholm last year, a resolution was adopted to the effect that geography ought to form a separate study of the school education.

A somewhat amusing quarrel has arisen between the parishes of

Kjelvik and Maasö (Norway) about a point of considerable geographical interest, viz, the proprietorship of the North Cape. It is caused by the establishment on the celebrated promontory of a restaurant, the taxes of which are claimed by both parishes. The cape has always been considered to form the boundary between the two, without it being stipulated to which it actually belonged.

The well-known rocky islet Munken (the Monk), which lies 3½ miles south of Sumbö, and formerly rose to a height of 70 feet above the sea, has completely subsided. A considerable portion of it had crumbled away last year, but it is now no higher than the low surrounding rocks, so that even in tolerably fine weather the sea breaks over and covers it. The shoal water about the islet causes such dangerous currents that the seamen of olden times believed there was a Malström there, and it is therefore very unfortunate that this rock, which served as a sea-mark, will no longer warn navigators of their approach to danger.

From recent observations it would appear that during the last thirty years or so the rising of the shores around the Baltic and Gulf of Bothnia has gone on with greater rapidity than during the previous period of observation. The increased rate of emergence in recent times is clearly shown on the rock known as Stora Reppen, not far from Pitea, Sweden. That rock in 1851 had emerged 94 centimeters above its former level since the commencement of the observations; while in August, 1884, it had risen 50 centimeters more. The general results compared with previous observations—that is for a period of one hundred and thirty-four years—prove that since 1750 the head of the Gulf of Bothnia has risen 2.10 meters, or 1.70 meters per century. This rate of emergence declines progressively toward the south. It is not more than 30 centimeters at Naze, and it is zero at Bornholm. The mean rise of the Swedish coast is thus 1.60 meters per century.

A very useful and complete atlas of Russia has been prepared by J. Poddubnyi, and published by A. Deubner, St. Petersburg, under the title of a "Russian school atlas," at the small price of one ruble, or 80 cents.

The project of connecting the Volga and the Don, which dates back to 1568, when Selim, the son of Solyman the Magnificent, besieging Astrakhan, attempted to join the two rivers in order to transport materials of war, has been revived. M. Léon Dru, a French engineer, having surveyed a line in October, 1885, was convinced that the project is practicable, and experimental borings have already commenced.

The attention of geographers and men of science ought to be called to several numbers of the *Archiv für die naturwissenschaftliche Landesdurchforschung von Böhmen*, which have recently been issued (Prague, Franz Rzuonatz). The numbers of most interest to geographers pure and simple are those forming the first division of the third volume, and containing a list of the heights in Bohemia, trigonometrically determined by the Imperial Institute of Military Geography in the years 1877–'79.

The first steamer coming directly from the open sea arrived at Cologne on March 18, 1885. It was called the Industry, and was of 513 tons burden.

The Austrian Government, with the consent of the Porte, has undertaken to make a geographical survey of the Albanian coast, with a view to preparing new maps. Two Austrian gunboats have accordingly left Corfu with officials of the chart department on board. They were joined by the Turkish officers, under whose superintendence the survey will be made. We may expect some definite results in the course of the next six months.

The Hungarian Society of Geography is engaged in organizing a Magyar expedition for the exploration of the region around the Urals; especially the Baskir country, where Urals-Altaû peoples are disappearing.

The Military Geographical Institute of Italy has published a memoir on the mensuration of the area of the Kingdom of Italy, with a new approximate estimate of the same. The figures are as follows, in square kilometers:

The peninsula of Italy	236,402·1720
The islets legally connected with its shores	368·8649
Sicily	25,461·2535
The Sicilian islets	278·8147
Sardinia	23,799·5607
The Sardinian islets	277·6027
Total	286,588·3000

This equals 110,652 square miles, and is about 10,000 square kilometers less than previous official figures, and 2,000 less than General Stebnitski's estimate.

Thoroddson's work in Iceland in 1884 seems to have been much fuller and more precise than the notes hitherto published would indicate. From the narrative published in *Globus*, it appears that in a journey of ten weeks over the Odádahraun desert and the adjacent mountains, about one-half was passed in an uninhabited region, much of which was completely unknown. He forced his way along the northern base of Vatna Jökull, the journey being frequently hazardous and always laborious. Many corrections of heights were made; and it seems that Jökulsa, which has been taken as the longest Icelandic river, is exceeded by Thiörsa, which is some 120 miles in length. An ascent of the unvisited Dyngja Volcano was made. It proved to have a double crater, the inner one being 600 feet or more in depth.

NORTH AMERICA.

The work of the several departments of Governments having to do with geodesy, geography, and hydrography has made satisfactory progress. In no one of them however has there been any special development of more than usual importance, while the routine work thereof—as well as that of the several State surveys, will be published in the respective reports. The topographic work of the United States Geological Survey during the past six months has been mainly in the office; the geographical map of the United States is rapidly approaching completion.

Prof. Asaph Hall, in *Science*, July 3, corrects the statement contained in the current edition of the Encyclopædia Britannica, that there is no land in Connecticut "above a thousand feet in elevation," and shows that there are certainly half a dozen points which exceed this limit, and at least two that run over *two* thousand feet.

The Arctic steamer "Alert" returned to Halifax on October 18, from Hudson's Bay, with the observation party which has spent fifteen months there testing the practicability of that route for navigation from the Canadian Northeast to Europe. They show the average temperature to be not so low as the average winter temperature in the Northwest. The lowest monthly average was 30° below zero. The ice observations show that Hudson Straits and Bay are navigable for properly built and equipped vessels for from three to four months, from July to October.

G. W. Dawson (*Science*, April 24) describes the Saskatchewan country, or that portion of the prairies which extends north of the northern boundary, as containing an approximate area of 300,000 square miles, and as less than 2,000 feet above the sea level, and thus lower than the corresponding portion of the continent farther south. Many interesting details will be found in this article.

So far as heard from, explorations in Alaska appear to consist of the journeys of Lieut. H. T. Allen and his companions; Lieutenant Cantwell; Assistant Engineer Samuel B. McLenegan and Seaman Nelson of the "Corwin"; Henry D. Woolfe; Lieutenant Stoney; and Doctor Everette.

Lieutenant Allen was sent by General Miles last year. He ascended the Copper or Atna River and explored its northern and western branch to its source, a distance of some 200 or 300 miles. He found the river rapid, with many cataracts, and having in some places a fall of 7 feet to the mile. Its width is variable, sometimes several miles, including large islands, at others but a few hundred feet. There are many glaciers near it, and the active Wrangel volcano rises almost from the river. A portage was made across this range to the sources of the Tananah, where there are a number of extensive lakes. This river was reached about 125 miles above the point to which it had been explored, and it and the Yukon were followed to the sea.

Lieutenant Cantwell has succeeded in getting to the source of the Kowak River, which consists of four large lakes, of which the most important is in latitude 67°, longitude 153° west. It is supposed to be 520 miles from the mouth of the river.

Assistant Engineer Samuel B. McLenegan, accompanied only by Seaman Nelson of the "Corwin," ascended the Noätak, also called the Nunatah or Inland River, which has been known for thirty years, but never explored. Its enters Hotham Inlet westward from the Kowak and about 30 miles north of the Arctic circle. The source of the branch ascended was found to be a small lake surrounded by snow-banks, and supposed to be 400 miles from the mouth. The voyage was extremely creditable to those who took part in it, though it is greatly to be regretted that exact observations could not have been made, and is noteworthy, as the party reached the highest latitude yet attained by white men in the interior of Alaska. The report and charts, which are being prepared by the Department, will doubtless fill a good part of the existing blank on the maps of this area.

Mr. Henry D. Woolfe, who has been stationed at Cape Lisburne during the past year, has travelled along the coast from that point to Hotham Inlet, and ascended the Noätak about 30 miles. Between the Corwin Lagoon and Cape Krusenstern a river falls into the sea, which he was informed is connected with the Noätak, running behind the hills which lie back of Shesholik village. Mr. Woolfe is preparing a map showing all the native settlements and even single huts temporarily occupied along the coast between Cape Krusenstern and Point Barrow.

Lieutenant Stoney's work, so far as it has gone, seems to be successful. He sent down a mail by the "Corwin", which arrived in San Francisco October 12. At that time he was near the head of Hotham Inlet and prepared to go into winter quarters. Details will not be published for a year yet.

Doctor Everette has collected a large amount of geographical data and made sketches along the Yukon, which will serve to enlarge our knowledge of Alaska and correct our maps.

M. Violet d'Aouest's note, read at the August meeting of the Geographical Society of Paris, on the aerial formation of soil will be found of great interest to geographers; a concise résumé is given in the Proceedings of the Royal Geographical Society for September.

The Danish exploring expedition to the east coast of Greenland under Lieutenants Holm and Garde, which returned to Copenhagen in October after a three years' absence, has fulfilled all expectations, having reached latitude 66° 08′ north, the northernmost point (on East Greenland) ever attained by Europeans. Lieutenant Holm is stated to have made some very valuable geographical and ethnological discoveries, having spent last winter among East Greenlanders never before visited by Europeans. He has named the stretch of coast explored, King Christian IX's Land. He considers it is now settled beyond a doubt that no early Scandinavian remains occur on the east coast.

Mr. Gamel, the owner of the vessel which has been put at Lieutenant Hovgaard's disposal for explorations in the Kara Sea in the summer of 1885, intends (provided his enterprise be seconded by the Government) to send his steamer "Dijmphna" next summer on an expedition to the east coast of Greenland under an officer of the Danish royal navy, to explore and lay down the coast line between 66° 08′ (the farthest northward point attained by Lieutenant Holm's expedition) and 70°.

SOUTH AMERICA.

Professor Seelstrang, of the University of Cordoba, has been appointed by the Argentine Government to superintend the publication of an atlas of the Republic, and a considerable sum has been appropriated for the work. It is to consist of 27 parts, and 4 of these are already in hand.

The Dutch scientific expedition in March and April last, to examine the upper course of the Surinam River, was quite successful. At Bergendal they took the height of the neighboring Blue Mountain, which they ascended and from which they had a view of the various mountain chains of Surinam.

M. Alcenar Œraripe read a paper on geographical neology and neography before the Geographical Society of Rio de Janeiro, in which he asks if there shall be a geographic neology for Brazil; a correction of orthography; and if so, how these can be brought about. The questions were referred to a commission, whose report has not yet been received.

The *Bolletino* of the Italian Geographical Society for July prints two un-edited letters of early Italian adventurers in South America, recently brought to light in the archives of Florence and Modena. The longer and more important, dated December 24, 1534, is addressed from Valenzuela (Venezuela) by a certain Tomaso Fiaschi to his brother in Florence.

Details of Mr. im Thurm's journey to Mount Roraima, British Guiana, are given by Mr. H. I. Perkins, who accompanied Mr. im Thurm, in the August number of the Proceedings of the Royal Geographical Society, and an illustrated article in *Nature;* April 30, 1885; vol. XXXI, pp. 607–10.

The Argentine expeditions into Patagonia have raised the agronomic credit of that country, which has long been supposed arid and sterile. The report of General Villejas, and that of Colonel Roa, who has travelled more than 500 leagues in Patagonia, affirm that the region near the base of the mountains is rich, not only in metals and minerals, but in fertile valleys which nestle between spurs of the range. With steam transportation between the mountains and the coast, it is affirmed that rapid growth of population might be expected and that prosperous communities might be established.

A party commanded by Feilberg, and sent out by the Argentine Government to explore the Pilcomayo, found that a trade route via that river to Bolivia is not feasible. Below the rapids, 60 leagues above the mouth, the Pilcomayo receives an affluent not marked on any chart, but with as much water as the Pilcomayo or perhaps more.

As a good example of what comprehensive geographical observation *ought* to be, we refer to Dr. W. Sievers's account of his travels in Venezuela, which appeared in the *Mittheilungen* of the Hamburg Geographical Society for 1884. He gives some interesting details of the effects still to be traced of the great earthquake which shook the north coast of South America on March 26, 1812, and describes a journey he made from Caracas to Puerto Cabello in November and December, 1884. Dr. Sievers was a pupil of Professors Richtofen and Wagner, and was trained as a geographer with a view to geographical explorations.

Mr. E. H. Glaisher's journey on the Berbice River and Wieroonie Creek will add materially to our knowledge of the interior of British Guiana, which has been almost a *terra incognita.*

M. Coudrean has—as the result of one of his six journeys in Guiana—brought back materials for two new maps, the one of the region between the Oyapock, Yari, Amazons, and Atlantic, the other of Southern Guiana between the Branco and Paru.

M. J. Chaffaujon's explorations on the Orinoco have already corrected many errors in the charts of its course. M. Thouar has gone on a new expedition to complete his work on the same river.

OCEANICA.

The first annual meeting of the Victoria branch of the Geographical Society of Australia was a most flattering success. The contributions were numerous, and many of them by distinguished authors.

Mr. B. Greenebaum, United States consul at Samoa, reports that a new island has been thrown up out of the sea about 40 miles off the Tonga Islands, bearing towards the Fiji Islands, and in the track of California vessels. It is 2 miles long and 250 feet high, and is in latitude 20° 28′ south and longitude 175° 21′ west. Mr. Shipley, consul at Auckland, New Zealand, confirms the above in a report to the State Department, and gives interesting particulars. He thinks the island is at least 2 or 3 miles long and 60 feet high, in latitude 20° 21′ south, longitude 175° 28′ west.

The death is announced from Sydney of Thomas Boyd, the first man to cross the Murray River and the last surviving member of Hume and Hovell's exploring party.

An excellent description and résumé of the history of the Caroline and Pelew Islands was published in *Nature*, September 10, 1885.

The April issue of the Proceedings of the Royal Geographical Society contains an account of a recent exploring expedition into the King country of the North Island, New Zealand. This country, containing some 10,000 square miles, is the Maori stronghold, and after the war of 1863–'64 white men were forbidden to enter, under pain of death. It had thus never been surveyed prior to Mr. Kerry-Nicholl's expedition, in 1883. In the course of 600 miles of travel twenty-five rivers, not previously shown upon the maps, and two small lakes were found; the source of the four principal rivers of the colony, the Whanganui, Waikato, Whangaehu, and Manganui-a-te-Ao, were traced; the hydrography of Lake Taupo in relation to the four distinct watersheds flowing into it was examined; the volcano of Mount Tongariro (9,300 feet) and Mount Ruapehu (9,000 feet), the highest peaks of the North Island, were ascended.

A Dutch expedition to New Guinea is being organized. The Government has promised a grant not exceeding 10,000 florins a year, and consequently the expedition is to be confined to geographical investigations. It will probably go to Dorch or to Onin.

Dr. Otto Finsch reports as some of the results of his work in German New Guinea that he traversed the north coast for a distance of 1,000 English miles, from East Cape to 141° east longitude (Greenwich). Several good harbors were discovered, and continuous meteorological and sounding observations made. A large river was discovered, which the doctor named after the Empress Augusta; its course was followed for 30 English miles into the interior. There is evidence of the existence of many other rivers. The German Emperor has ordained that the harbor shall henceforth be known as "Friedrich Wilhelm's Hafen," and the bay near it "Prince Heinrich's Hafen"; the large navigable river east of Cape de la Torre as the "Kaiserin Augusta Fluss"; while Beaupré, situated in the middle of the peninsula, will now be called "Varzin." "Neu Mecklenburg" will be substituted for New Ireland; "Neu Lauenburg" for the Duke of York group, and "Neu Pommern" for New Britain, the largest island of the Bismarck Archipelago.

Dr. P. L. Sclater suggests "Torresia" as an appropriate name for British New Guinea.

The Geographical Society of Australia has completed arrangements for the exploration of New Guinea, and a fully-equipped expedition has started under the leadership of Capt. Henry Charles Everill. The rumored massacre of the entire party is discredited by the British resident on Thursday Island.

Mr. H. O. Forbes is now engaged in the same field. He has accepted a contribution of £500 from the above-named society, with the condition that he gives it a full report of his journey, and second sets of collections. After various mishaps the expedition arrived safely at Port Moresby (see Proceedings Royal Geographical Society December), in company with Sir Peter Scratchley, early in September, and made immediate arrangements to start for the interior in company with the Rev. Mr. Chalmers. Mr. Forbes is going to attempt to reach the summit of Mount Owen Stanley, 13,205 feet high, and hitherto untrodden by the foot of man.

The Geographical Society of Hamburg has published a memorandum showing the territorial extent of the recent German annexations in the Pacific Ocean. Reduced to English measurements, the German estimates are as follows: Kaiser Wilhemsland (German New Guinea), 34,508 square miles; Neu Mecklenburg (New Ireland), 3,398·8 square miles; Neu Pommern (New Britain), 9,348·8 square miles; the Bismarck Archipelago, 15,261·6 square miles; in all about 65,512 English geographical square miles. The same authority estimates the area of New Guinea taken under British protection as 65,517·76 square miles, or about the same as the total of German annexations in the Pacific, and in each case the area acquired is rather more than twice that of Ireland.

ARCTIC REGIONS.

In a communication to the New York *Tribune* last February, Lieutenant Greely advocates the route by Franz Josef Land to the Pole, and gives his reasons for so doing at some length, confirming the opinion previously expressed by Chief Engineer Melville. Captain Sorensen—who speaks from large experience and after close observation of the ice drift in that vicinity, suggests that Spitzbergen and Franz Josef Land form parts of a vast archipelago, and not two wholly distinct territories, as has hitherto been believed.

When the "Corwin" returned from Bering Sea to San Francisco in June for some repairs, she reported the ice unusually far south in April and May in that sea. The same state of affairs existed in the Atlantic. The captains of several Norwegian steamers dispatched to Greenland for seal-hunting, report that in consequence of the enormous ice masses on the east and south coasts no seals had been killed by any vessel. The state of the ice this summer seems to have been just the reverse of that of last year, when the coast was unusually free from ice. If the recently promulgated theory that this is an evidence of mild weather in the polar regions is at all correct, it is unfortunate that no expedition is in the field to take advantage of it.

Four Arctic expeditions are said to be projected for next year: two organized in Portugal, one in Holland, and one in Denmark. They all propose to visit the islands of the glacial ocean which belong to Russia; but the Danish expedition will specially explore the Kara Sea and the northern coast of Siberia, to define if possible the unknown region which is supposed to lie to the northeast of Novaya Zemlya.

In the latter half of 1883, Dr. F. Boase visited the German polar station in Cumberland Sound, and made several excursions in the neighboring region and along the coast. The results are briefly told by him in a paper in numbers 5 and 6 of the *Verhandlungen* of the Berlin Geographical Society for this year (accompanied by map), in which many important corrections are made in the existing admiralty charts of these coasts.

At the meeting of the Naval Institute, which was held in Annapolis October 9, Lieut. J. W. Danenhower, of the "Jeannette" expedition, presented an essay on the advisability of further Arctic explorations, and expressed himself as opposed to further work north of the 85th parallel. The paper was supplemented by others received from Chief Engineer Melville, U. S. N., Sir George Nares, and Lieutenant Greely, and verbally discussed by Dr. Emil Bessels, of the "Polaris" expedition, and Mr. Clements R. Markham, of the Royal Geographical Society, who presided at the meeting. Letters in favor of further Arctic exploration were read from Prof. J. E. Nourse, U. S. N., and Dr. H. Rink, formerly governor of the Danish colonies in Greenland. The general tenor of the discussion, both oral and written, was that *scientific* exploration of the Arctic regions will go on.

Mr. C. R. Markham, in his article "Polar Regions," of the current edition of the Encyclopædia Britannica, permits himself to make the following remarkable misstatement: "Lieutenant Lockwood made a journey along the north coast of Greenland, and reached a small island in 33° 24′ [north latitude] and 44° 5′ [west of Greenwich]. Dr. Pavy and another went a short distance beyond the winter quarters of the "Alert," and a trip was made into the interior of Grinnell Land. *But all this region had been explored and exhaustively examined by the English expedition in* 1875–'76." The italics are ours.

Dr. Leonard Stejneger's illustrated article on the Commander Islands in Heft 3, Band VIII, of the *Deutsche geographische Blätter* is of special value, in that it settles definitely the doubt that has existed as to the death of Bering. The writer visited and described the ruins of the hut on Bering Island in which Bering and his companions wintered 141 years previously, and where the celebrated traveller himself died and was buried. The relics found by Dr. Stejneger are of great, if melancholy, interest.

HYDROGRAPHY.

The U. S. S. "Alert" has been engaged for some time in surveying the coasts of Corea. The returns have not yet been charted by the Department.

The last report from the U. S. S. "Ranger's" work on the west coast of Central America embraces 100 miles of coast between San Juan del Sur and the Gulf of Dulce; this connects the former surveys with the English detail work from Panama northward.

The new chart of the harbor of Payta is an excellent specimen of the standard which Commander John R. Bartlett has established for the future work of the Hydrographic Bureau of the Navy Department. The reduction of the photographic view of the anchorage will be of the greatest service to mariners. The old Spanish charts of Porto Rico and other West India islands have been verified, and as fast as possible this verification will be extended to all the harbors of the West Indies. A chart of the Arctic Ocean, constructed on the ordinary conical projection, enables one to study those regions with the utmost facility.

Returns have just been received from the summer's work of the Coast Survey steamer "Carlile P. Patterson" in Southern Alaska. An immense extent of territory has been covered and in a most thorough manner, the ground being comparatively virgin, as the rough work by the Russians scarcely served as reconnaissance. The surveys off the coast of Maine and the general routine work during the six months covered by this report have not developed anything of special importance.

The *Deutsche Seewarte* as issued a chart of the ice in the Atlantic Ocean this spring, which penetrated very far south and east, in consequence of continuous northerly and northwesterly winds. Several icebergs appear to have been found in the Gulf Stream. It seems from experience that toward the end of June the ice recedes northward, while between the banks and the east coast of Newfoundland it remains longest, even after it has disappeared south and southeast of the banks.

Among the most important additions to our hydrographical knowledge are the following: Survey of Little Bahama Bank and southern shore of Newfoundland; main Strait of Magellan; additions to ports and coasts of Southeast Africa; in the Red Sea the intricate approaches to Suakim have been well laid down; Penang harbor has been resurveyed and the positions of the islands lying to the northwest, and forming the eastern boundary of the ordinary route of vessels to Malacca Strait, have been accurately determined; the unknown western shores of Corea, south of the approach to Söul, for two degrees of latitude, have been explored, and the main features of that island-studded shore laid down, new rivers and harbors have been entered, notably the large river Gun san-gang, at the entrance to which stands the considerable town of Makfo; the southern approach to Haitan Strait on the Chinese coast has been recharted; in the Solomon Islands the Bougainville Strait has been charted; many additions have been made to the charts of various groups of Pacific Islands; the survey of the coast of India by officers of the British navy and India marine, has been actively progressing, surveys of Rangoon, Cheduba, and other ports in the Bay of Bengal, as well as harbors on the west coast of Hindustan have been made; a resurvey of the great Canadian lakes has been commenced in Georgian Bay.

The Italian corvette "Vettor Pisani" commanded by G. Columbo, recently completed a three years' circumnavigation of the globe, with suitable outfit and instructions for scientific hydrography. The regions visited included both coasts of South America, from Pernambuco on the east, south to Magellan Straits, and north to Panama, the Galapagos and Hawaiian Islands, the China, Indian, and Red Seas, and so home. The results of the voyage are very satisfactory, many deep-sea soundings having been taken, numerous charts corrected or resurveyed, and general hydrographic information gathered.

One of the most interesting features of the Aberdeen meeting of the British Association was the lecture given by Mr. John Murray, director of the "Challenger" publications, on the results of deep-sea research, especially as considered from the hydrographer's standpoint.

The Proceedings of the Royal Geographical Society for September contain the following: "We received in the course of the past month two communications relating to the picking up of bottles with inclosed memoranda cast overboard by enterprising ship captains' with a view to testing the direction of what may be called the secondary currents of the Atlantic. One of the communications is from the German consul at Fayal in the Azores, and is to the effect that one day, about the beginning of July last, a bottle was picked up 'near the coast of the island of Pico,' north latitude 38° 26′, west longitude 28° 35′, the contained papers stating that it had been thrown overboard from the Hamburg steamship "Bohemia" on August 23, 1884, in north latitude 42° 4′, west longitude 52° 12′. The inference to be drawn from this case is that the southerly current thrown off by the Gulf Stream in this part of the Atlantic is one of extreme slowness. The other communication is from Herr H. Wolff, of Grand Popo, West Africa. Writing on the 30th day of May last, he informs us that a negro in his employ found on the beach near Grand Popo a bottle, the inclosed papers of which state it was thrown overboard from the ship "Patriarch" (from Newcastle, N. S. W., bound for London) on the 11th December, 1884, in north latitude 2° 46′, west longitude 22° 3′. This point is near the southern edge of the Guinea current, which thus appears to have taken five months to carry the bottle some 1,200 geographical miles from west to east."

PHYSICS.

By George F. Barker, M. D.,

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GENERAL.

The lectures on Molecular Dynamics, given by Prof. Sir William Thomson at the Johns Hopkins University, Baltimore, in October, 1884, mark an epoch in the higher physical instruction of this country. They were devoted to a discussion of the wave theory of light, considering (1) the propagation of a disturbance through an elastic medium, (2) the character of molecular vibration, and (3) the influence of molecules on the propagation of waves. The lectures dealt largely with the difficulties of the wave theory, the first enumerated being the difficulty of explaining the dependence of velocity of propagation on period of vibration, the second the properties of the æther, the third certain phenomena of reflection and refraction, and the fourth those of double refraction. As to the first difficulty, he devoted a very considerable space to Helmholtz's theory, which ascribes dispersion to a compound structure of material molecules according to which they have a natural period of vibration, suggesting an ingenious mechanical (Helmholtz-Thomson) spring and shell molecule to represent it. As to the æther, he has no difficulty in reconciling its almost perfect rigidity with almost perfect mobility, since the question is merely one of time. The æther may be highly elastic for vibrations executed in the 100 or 1,600 million millionth of a second, but highly mobile to bodies going through it at the rate of 20 miles a second. As to the manner in which the molecule imparts its motion to the ether, he says: "The kind of thing that the luminous vibrator consists in seems to me to be a sudden initiation of a set of vibrations and a sequence of vibrations from that initiation which will naturally become of smaller and smaller amplitude. Why a sudden start? Because I believe that the light of the natural flame or of the arc light, or of any other known source of light, must be the result of sudden shocks from a number of vibrators. Take the light obtained by striking two quartz pebbles together. You have all seen that. There is one of the very simplest sources of light. What sort of a thing can the light be that proceeds from striking two quartz pebbles together? Under what circumstances can we conceive a group of waves of light to begin gradually and to end gradually? You know what takes place in the excitation of a fiddle string or of a tuning fork by a bow. The vibrations gradually get up from zero to a maximum, and then, when you take the bow off, gradually subside. I cannot see anything like that in the source of light. On the contrary, it seems to me to be all shocks—a sudden beginning and gradual subsidence." But it is the double refraction difficulty which is most serious. When the medium is displaced during wave propagation in a doubly refracting crystal, the return force must depend on the direction of vibration, and not on the plane of distortion, as theory indicates. Rankine's suggestion of a cavity in the luminiferous ether having a massless, rigid lining, and containing a massive, heavy molecule with fluid round it, seemed to solve the difficulty. But the form of wave surface deduced from such a hypothesis does not agree with Fresnel's, as Rayleigh has shown. "It appears, then," says Professor Forbes, in his excellent résumé of the lectures, "that after all the labor which has been expended upon the wave theory of light it fails absolutely, and as it seems hopelessly, in two points of primary importance. One is the extinction of the ray polarized by reflection; the other is double refraction. In other matters we have difficulties, but we can see a possible means of escape. Here there seems to be none." (*Nature*, March, April, 1885, XXXI, 461, 508, 601.)

At the Aberdeen meeting of the British Association, Stoney showed that the mass of a molecule of hydrogen must be a quantity of the same order as a decigram divided by 10^{24}, *i. e.*, a twenty-fourth decigrammet, which is the same as a twenty-fifth grammet. Hence the mass of the chemical atom of hydrogen may be taken to be half of the twenty-fifth of the grammet. This value is based on the conclusion reached by several physicists that the number of molecules in a cubic millimeter of a gas at ordinary temperature and pressure is somewhere about a unit eighteen (10^{18}); from which it can be shown that the number of molecules per liter must be about a unit twenty-four (10^{24}). From this, together with the weight of a liter of hydrogen, the above value for the mass of a molecule of hydrogen has been deduced. (*Nature*, November, 1885, XXXIII, 21.)

In a paper on the identity of energy, Lodge has drawn some interesting conclusions from an important memoir by Poynting, presented to the Royal Society. In this memoir the author introduces "the idea of continuity in the existence of energy; so that whenever energy is transferred from one place to another at a distance it is not to be regarded as destroyed at one place and recreated at another, but is to be regarded as transferred, just as so much matter would have to be transferred; and accordingly we may seek for it in the intervening space and may study the paths by which it travels." Lodge regards this new form of the doctrine of conservation of energy as much simpler and more satisfactory than the old one; and he proves it rigidly and instantaneously from Newton's law of motion (usually stated as three), on the one hand, and a denial of action at a distance on the other, thus: "If A does work on B it exerts force on it through a certain distance; but (Newton's law) B exerts an equal opposite force and (being in contact) through exactly the same distance; hence B does an equal opposite amount of work or gains the energy which A loses. The stress between A and B is the means of transferring energy from A to B, directly motion takes place in the sense AB. And the energy cannot *jump* from A to B; it is transferred across their point of contact, and by hypothesis, their 'contact' is absolute; there is no intervening gap, microscopic, molecular, or otherwise. The energy may be watched at every instant. Its existence is continuous; it possesses identity." Obviously A and B cannot be "pieces of matter" in the ordinary sense, since then they cannot be in contact. If A and M be contiguous material molecules, energy may be transferred from A to M, but not directly; A cannot act on M, cannot do work on it, because of the intervening gap. A can transfer its energy to B, B to C, C to D, and so on, handing on the energy to L, which is in contact with, and can act on, M, doing work on it and giving up to it the energy lost by A. A, B, C, &c., are supposed to be successive portions of the perfectly continuous space-filling medium—æther. The distinction between potential and kinetic energy is then discussed, and the conclusion stated: (1) Energy cannot be transferred without being transformed; nor conversely can it be transformed without being transferred; and (2) it always transforms itself from kinetic to potential or vice versa. "When A does work on B, energy is transferred from A to B; if the energy lost by A is kinetic, that gained by B is potential; if, on the other hand, A loses potential then B gains kinetic energy." Hence "the common mode of treating a falling weight, saying that its energy gradually transforms itself from potential to kinetic, but remains in the stone all the time, is, strictly speaking, nonsense. The fact is the stone never had any potential energy; no rigid body can have any; the gravitation medium had it, however, and kept on transferring it to the stone all the time it was descending." Change of form is therefore necessary and universal whenever energy is transferred, *i. e.*, whenever any kind of activity is exhibited by any known kind of material existence. (*Phil. Mag.*, June, 1885, V, XIX, 482.)

Groshans has announced a new law connecting the boiling points and densities of substances with their atomic composition, which law he calls "The law of Density-numbers." These density numbers form a new class of constants, and are attributes of the elements; they are whole numbers, and each element possesses only one, though two or more elements may possess the same number. They increase with the atomic weights, but are not proportional to them. From the values thus far obtained, the author suggests the hypothesis that carbon, oxygen, and hydrogen are simple bodies, the other elements being compounds of other simple substances, the number of atoms of which is shown by the density number of each element. He enunciates the law in the following simple form: "The densities of substances are proportional to the density numbers." Of course it is necessary that the substances compared should be under similar conditions; and then the ratio of the sum of the density numbers to the density is constant. Thus for a series of hydrated crystalline salts of the formula RCl_2 $(H_2O)_6$ this ratio varies from 19·85 to 20·00. Various other applications of the law are given. (*Phil. Mag.*, July, August, 1885, V, xx, 15, 191.)

Lodge, in his lecture on Dust, at the Montreal meeting of the British Association, defined it to be all foreign matter, of whatever kind, suspended in the air. Its function in causing the blue color of the sky and the diffusion of sunlight was discussed. If the atmosphere were purely gaseous, holding no minute foreign bodies in suspension, the sun would glare down directly with blinding intensity, and objects not in its direct rays would be in almost complete shadow. The sun would be set in a black firmament, and it would be easy to see the stars at noonday. But so far from this, the sun's rays, on reaching our atmosphere, are partially intercepted, diffused, and scattered by myriads of most minute particles, so minute as to be even smaller than the light waves themselves, which act therefore more powerfully on the smallest of these waves than on the largest. The light thus scattered has a preponderance of small waves, owing to the minute size of the scattering particles, and hence it affects our sight organ with the sensation of blue. The function of dust in causing vapor condensation was then considered, and the theory of Aitken illustrated by experiment. Five methods of removing dust from the air were mentioned: (1) Filtration through cotton wool, either alone or mixed with glycerin; (2) settling, especially in hydrogen; (3) condensing vapor in the air several times; (4) calcining the air, or keeping a hot body in it for some time; and (5) discharging electricity into it from a point. He points out that the action of a hot body in keeping the dust away from itself is due to molecular bombardment; Tait, Dewar, and Reynolds having shown that a Crookes bombardment is effective at ordinary pressures, provided the bodies bombarded are small. Dust particles, being very small, are driven by molecular impact away from hot bodies toward cold ones. Hence we observe that articles in a room warmed by radiation, and therefore warmer than the air of the room, are not likely to become as dusty as those in a room warmed by hot air, where the air is warmer than the articles. The rapid deposition of dust by electrification was shown by discharging the current of a Voss machine from a point into an atmosphere containing magnesium smoke. Thus, possibly, the air is cleared by thunder storms, and thus fog might possibly be dissipated at sea. (*Nature*, January, 1885, xxxi, 265.)

Genocchi has published a historical note on the pendulum experiment for determining the earth's rotation. Poleni, in 1669, in noticing a memoir of Huygens, says that, in consequence of the earth's rotation, a pendulum could not remain in the same plane during two consecutive oscillations. De Sivry, in 1782, in his translation of Pliny, observes that the pendulum might be used in place of a compass, "the vessel in turning about not altering by this motion the direction of vibration once given to the pendulum." In 1837 Poisson, while admitting the deflecting influence of the earth's rotation upon a projectile, denied the possibility of any deviation whatever for the pendulum; and in order to sustain his opinion, he attempted to prove mathematically that the component perpendicular to the oscillatory plane was too small to cause any sensible deviation of the pendulum from its plane, or to have any appreciable influence on its motion. This opinion was refuted by Binet and Plana in 1851. Poncelet, in 1860, showed that the phenomenon was much more complicated than had been generally supposed; and finally, W. Dumas and Serret gave the complete theory of the experiment. (*J. Phys.*, March, 1885, II, IV, 147.)

In constructing the reversible pendulum of Bohnenberger, Weber has proposed to place the knife edges in such a way that any given variation of their distance may have the least possible influence upon the duration of oscillation. With a cylindrical rod he finds that this condition is realized when $t = \sqrt{\frac{3{\cdot}02045\,a}{g}}$ and when the knife edges are placed symmetrically at a distance from the center $x = 0{\cdot}37835\,a$; a representing the moment of inertia of the pendulum around its center of gravity. The value of a may be calculated geometrically and the length of the simple synchronous pendulum l in the formula $l = 3{\cdot}02045\,a$ be deduced from a determination of the time t, without having any measurements of length to make other than those of the geometric dimensions of the rod. (*Wied. Ann.*, XXII, 439; *J. Phys.*, November, 1885, II, IV, 510.)

Oppolzer has obtained, by means of a Repsold reversion pendulum, the provisional value 0·993825 meter for the length of a seconds pendulum in Vienna, lat. 48° 13′ 57″, altitude 236 meters. (*Ber. Ak. Wien.*, 1884, p. 2; *J. Phys.*, April, 1885, II, IV, 184).

Sakai and Yamaguchi have determined the gravitation constant in C. G. S. units at Kagoshima and at Naha, in the Loo Choo Islands, using the method employed by Mendenhall in Tokio. The value at Kagoshima was 979·561 ± 0·0057, and at Naha 979·165 ± 0·0055. (*Am. J. Sci.*, May, 1885, III, XXIX, 404.)

Bartoli has speculated on the mean density of a body containing all the known elements in a solid state, either uncombined, or, if partly combined, each retaining the density belonging to it in the solid state. He makes three suppositions: (1) The masses of all the substances equal; (2) the masses such that the corresponding volumes shall be equal, and (3) the masses in the ratio of the atomic weights. In this way he arrives at the mean densities 2·698, 7·027, and 5·776, this last value, as he points out, coming very near that got by Cavendish for the mean density of the earth, which was 5·67. (*Nature*, October, 1885, XXXII, 635.)

Wilsing has revived the use of the pendulum for determining the earth's mean density, and has shown that the necessary sensitiveness may be secured by adjusting so that the center of gravity comes close under the axis of oscillation. In his experimental apparatus fixed leaden balls, each weighing 300 grams, were placed at the ends of a prismatic rod of thin sheet iron, the steel knife edge being in the middle of the rod and resting on agate planes. After adjustment to equilibrium, the attracting masses were brought near the leaden spheres and the deflection read by means of a mirror and scale. From the value thus obtained the ratio of the deflecting attraction to the constant of gravitation can be deduced. By reversing the direction of the deflecting force the total deviation is doubled. An improved apparatus, in process of construction, will, it is expected, give accurate results. (*Ber. Ak. Berl.*, January, 1885; *Phil. Mag.*, March, 1885, V, XIX, 219; *Am. J. Sci.*, May, 1885, III, XXIX, 402.)

König and Richarz have suggested an improvement of Von Jolly's method for determining the earth's mean density. A cubical block of lead, about 2 meters in the edge and weighing 100,000 kilograms, is so placed that the center of its upper horizontal surface is exactly beneath the middle knife edges of an extremely delicate balance. Beneath the center of each scale-pan the block is bored vertically through, and two other scale-pans are suspended below the block by means of rods passing through these openings. A weight in one of the upper pans is balanced by weights in the opposite lower pan. The former is acted on by the earth's attraction plus that of the block, the latter by the difference of the two. Hence, the weights in the lower pan are greater than those in the upper by twice the attraction of the block. A second weighing is then made, the other two pans being now used. The difference of the two weighings gives four times the attraction of the block. (*Ber. Ak. Berl.*, December, 1884; *Phil. Mag.*, February, 1885, V, XIX, 148; *Nature*, January, March, 1885, XXXI, 260, 408, 484.)

MECHANICS.

1. *Of Solids.*

In a paper read at the Aberdeen meeting of the British Association, Osborne Reynolds discussed a new and very fundamental property of granular masses composed of rigid particles in contact, which property he calls *Dilatancy*. It is exhibited in any arrangement of particles where change of bulk is dependent upon change of shape. In fluids change of shape and volume are independent, but in solids they are sometimes not separable. With granular masses change of shape always produces change of volume, and if change of volume is prevented any change of form is impossible. Thus a sack of corn is flexible on end, but becomes hard when placed on its side, and its shape will not alter. But if the sack be made of rubber, since the boundary of the granular mass is now extensible, it remains perfectly flexible in all positions. However, if it be possible with an extensible envelope to impose a maximum volume upon the contents, effects similar to those obtained with the inextensible boundary may be expected. This can be done, for example, by placing No. 6 shot in a rubber bag and adding a certain amount of water. If the quantity of water be such that the spaces between the granules when in close arrangement are all filled by it, while with a wide arrangement the amount is not enough, a point will be reached in passing from the first to the second arrangement such that any further change of shape and consequently of volume would produce a vacuum. When this stage is reached the whole mass becomes perfectly hard. When the foot presses upon wet sand, that portion of it immediately surrounding the foot becomes momentarily dry. The sand being completely filled with water, the pressure of the foot causes dilatation, and so more water is required. This is drawn in from the surrounding sand leaving it dry until a sufficient supply has been drawn up from below. On raising the foot the sand contracts again and the excess of water escapes again wetting the sand under and around the foot. The author conceived that the property of dilatancy placed a hitherto unknown mechanical contrivance at the command of those who would explain the fundamental arrangement of the universe; and he proceeded to explain how bodies in such a medium would, in virtue of the dilation caused in the medium, attract each other at a distance with a force depending on the distance which might well correspond with gravitation. Further, owing to the existence of a region close to the body in which the density varies several times from maximum to minimum, the mutual force might undergo a change from attraction to repulsion, and this more than once, as the bodies approach a condition which seems to account for cohesion and observed molecular force far better than any previous hypothesis. (*Phil. Mag.*, December, 1885, V, xx, 469; *Nature*, October, 1885, XXXII, 535.)

Von Helmholtz has suggested an improved method of measuring the modulus of elasticity of solids. Ordinarily the bar is firmly supported at its ends and the flexure produced by loading it in the middle is measured with the cathetometer. Under these circumstances, however, a considerable error is introduced by the compression at the points of support. To eliminate this Von Helmholtz uses two perpendicular mirrors at the ends of the bar, their reflecting surfaces being directed inwards. A scale is placed opposite one end of the bar and a reading telescope opposite the other. The image of the scale is seen in the one mirror as reflected in the opposite one. As the bar is loaded and becomes flexed the image is displaced to an amount proportional to the angular changes of the mirrors. The amount of flexure for different loads is a simple matter of observation therefore, and is independent of the effect of the pressure on the supporting edges. König proposes the use of the analogous method of Kirchhoff for determining Poisson's constants; only, instead of using two horizontal mirrors and two telescopes, two parallel mirrors inclined at an angle of 45° should be used at the two ends of the bar, with one telescope. In this way the moduli of elasticity and of torsion may be measured and the constants in question calculated. (*Nature*, August, 1885, XXXII, 360.)

Frederick Siemens has improved greatly the processes for tempering glass, and consequently the product obtained. The scientific principle underlying these consists simply in keeping the whole body of the glass at a uniform temperature during the operations of heating and cooling. The De la Bastie process is wrong in principle, since it leaves the glass in a state of tension; while the glass treated by the new process is almost entirely free from internal stress. Three distinct processes are made use of; in the first, called press-hardening, the very best quality of glass is used. It is cut into the proposed shapes, softened in the furnace, and cooled between metal plates, the degree of hardening depending upon the temperature to which the glass is heated and the rate at which it is cooled. It may be cooled so rapidly that a diamond will not scratch it, a result obtained in the case of sheet and plate glass for the most part, either plain or decorated; increasing its strength eightfold. For sheets of ordinary thickness, the heating occupies a minute and the cooling half a minute, and this without injury to the glass. The second process, called semi-hardening, is applied to articles not adapted to the press. These are heated up to the verge of softening and then placed in an iron casing having projecting ribs to give the necessary support, the whole being cooled in the open air. The strength of the glass is increased about three times. The glass made in the third process is called hard-cast glass, and is used for grindstones, sleepers, car-rails, and floor plates. It is made in a continuous melting furnace and run into molds made of imperfectly conducting materials, such as mixtures of porcelain, glass pots, heavy spar, magnetic iron, &c., pulverized and then molded as in casting iron. After the glass is run into the mold the whole is heated up and rapidly cooled. To show its homogeneity a tuning fork was made of it which gave a clear musical note. (*Nature*, March, 1885, XXXI, 413.)

Sherman has called attention to the relation obtained by Weber between the residual elasticity of glass and its chemical composition, the former value being deduced from the observed depression of the column after heating. Plotting the results obtained, the ordinates representing depression in tenths of a degree and the abscissas the ratio of potash to soda, Sherman notes the fact that while the greater portion of the observations may be represented by a smooth curve, yet several of the points lie farther from the curve than can be accounted for by errors of observation; the composition of the glass being identically the same for some of these points and for some lying in the curve. Except in one case, the departures are less than the maximum differences afforded by the depressions observed on a single thermometer. In this case, the only one where the depression is diminished, the lime, soda, and potash exist in the glass in nearly equal amounts. (*Am. J. Sci.*, May, 1885, III, XXIX, 385.)

Bartoli has sought to show the non-permeability of glass to gases by means of a polarization test. A glass trough divided vertically in the middle was filled with a solution of sodium sulphate. On opposite sides of this partition were fastened thin gold electrodes, a second electrode, also, of gold, being in each cell. The two electrodes of one of these cells were connected with a delicate galvanometer, those of the other with a strong battery. But no effect was produced upon the galvanometer. Since any trace of either oxygen or hydrogen by passing through the glass would have polarized one of the galvanometer electrodes and produced a current, the author concludes that the glass is not permeable to gases. (*Il Nuovo Cimento*, III, XVI, 78; *J. Phys.*, December, 1885, II, IV, 556.)

Trowbridge and McRae have determined by several methods the coefficient of elasticity of ice. Bars prepared by freezing water in metallic tubes were vibrated transversely and made to record their vibrations simultaneously with those of a tuning fork of known pitch. The values of E in two experiments were 66×10^9 and 55×10^9 absolute units. Bars of ice were cut from a pond, supported at the ends, weighted, and the deflection measured by a cathetometer. The values in the four series of observations were 57×10^9, 65×10^9, 71×10^9, 96×10^9, the mean being 72×10^9. By the method of longitudinal vibrations, the pitch of the note being 0.3 of a semi-tone of C sharp, the modulus for a bar of ice 138 centimeters long was found to be 86×10^9 absolute units. The calculated velocity of sound in ice is therefore 2,900 meters per second, or about nine times the velocity in air. (*Am. J. Sci.*, May, 1885, III, XXIX, 349.)

Trotter has communicated to the Royal Society the results of some experiments made at the Grindelwald glacier to ascertain whether direct evidence of shearing could be obtained in ice under the action of forces produced by the action of gravity. Bars of ice were passed through holes in three parallel blocks of wood nearly in contact, the two outer ones being hung to a frame, while a weight was hung to the middle one. In a final experiment a shear of about 0.075^{cm} was observed after the action during seventeen days of a shearing force of rather more than 200 grams per square centimeter. He therefore thinks that "there is little doubt that, under conditions closely resembling those in the interior of a glacier, and under the influences of forces comparable with those which gravity is capable of exerting in a glacier, hand specimens of ice shear in the same manner as a truly viscous solid would do." (*Nature*, February, 1885, XXXI, 328.)

Morgan has made a series of experiments on the viscosity of ice, which, taken in connection with results obtained by other experimenters, are of great interest. In the first a cylinder of ice 3 inches in diameter was supported on a board, and over it a wire was hung loaded with a total weight of 5 pounds. The whole was placed in the snow chamber of a refrigerating apparatus for six and a half hours at a temperature never above —12°. No dent was observable on the surface of the cylinder. The second experiment was similar, the weight being increased to 10 pounds and the time to eight hours, but the result was the same. In the third, the weight was 14 pounds and the time seventeen and a half hours, but no indentation was observable. In the fourth experiment a bar of ice 2½ inches wide and 1½ thick was supported on bearers 13½ inches apart, from Monday noon to Saturday noon without perceptible flexure. In the fifth the bar was weighted in the middle for the same time with 7 pounds, but with the same result. In the sixth, 18 pounds weight acting for the same time gave no perceptible deflection. In the seventh a similar though thinner bar, varying from ·625 to ·875 of an inch in thickness, was weighted for four days with 7 pounds and for two days with 7 pounds additional. No bending could be detected by measurement. The author cites experiments at other temperatures, and concludes that the viscosity of ice is considerable at temperatures at and above the melting point, is much less below but near this point, is very slight between —3.5° and —12°, and is *nil* below —12°. (*Nature*, May, 1885, XXXII, 16.)

Fromme has observed that the purely mechanical interpretation of the change of properties which steel undergoes by hardening, in which the pressure which the external layer suddenly cooled exerts on the internal portions, plays a prominent part, leads to consequences concerning the density of a tempered mass of steel which are not always in accord with experiment. It must be admitted that this mechanical action produces so close an approximation of the molecules that a consecutive chemical action results, *i. e.*, the combination of the iron and the carbon. In this way it is not difficult to see that slow cooling, effected under a considerable pressure, can produce the physical effects of hardening, as the experiments of Clemandot and Lan have shown. (*Wied. Ann.*, XXII, 371; *J. Phys.*, December, 1885, II, IV, 583.)

2. *Of Liquids.*

In conjunction with Vicentini, Pagliani has determined the coefficient of compressibility of water at various temperatures. At 0° it is 0·0000503; at 10°, 0·0000470; at 20°, 0·0000445; at 30°, 0·0000425; at 40°, 0·0000409; at 50°, 0·0000397; at 60°, 0·0000389; at 70°, 0·0000390; at 80°, 0·0000396; at 90°, 0·0000402; and at 100°, 0·0000410. The same author, working with Palazzo, finds the compressibility of ethyl alcohol to be represented by the empirical formula $\mu_t=\mu_0$ (1+0·003177t+

$0{\cdot}0000550t^2$). With respect to mixtures, the authors find (1) that the addition of small quantities of alcohol lowers the compressibility-coefficient of water; (2) that this diminution continues to increase until the alcohol constitutes 23 per cent.; (3) that for mixtures containing less than 19 per cent. of alcohol, the coefficient diminishes as the temperature rises from zero upward, there being for each mixture a temperature where it is a minimum; and (4) that the temperature of minimum compressibility is always lower for these mixtures than for water. There appears to be no relation between the temperature of maximum density and minimum compressibility of these mixtures. (*J. Phys.*, August, 1885, II, IV, 371.)

Terquem has translated from Vitruvius an account of the process by which Archimedes determined the composition of the crown of Hiero, which differs from that ordinarily received. After the discovery in the bath, he caused to be made two masses equal in weight to that of the crown, the one of gold the other of silver. Then having filled completely with water a vessel of known capacity he plunged into it the mass of silver. A quantity of water equal to the volume of the silver overflowed. Removing the metal, he poured water into the vessel until it was again full, measuring the quantity of water thus used. In this manner he ascertained the volume of water corresponding to a known weight of silver. This experiment was then repeated with the mass of gold, the volume of which was found proportionally less. On immersing the crown in the same vessel, he observed that a greater volume of water overflowed than was displaced by the mass of gold of the same weight; and from the quantity which overflowed in the former case over that in the latter he calculated the amount of silver which the crown contained. Hence it would appear that Archimedes did not make use of the upward pressure of liquids in this experiment, as is generally assumed, but employed a process analogous in principle if not identical with that of the specific gravity bottle. (*J. Phys.*, August, 1885, II, IV, 384.)

Schiff has devised a simple form of apparatus for determining the specific density of liquids at high temperatures based on the principle of the weight thermometer. The bottle used, which has a capacity of 8 or 10$^{c. c.}$, has a recurved neck over which is a helmet ground air tight. It is filled with the liquid and weighed, then submitted to the required temperature and the excess of liquid allowed to overflow into the helmet. A second weighing after cooling gives the weight of the liquid remaining and hence of the overflow, from which the density of the liquid at the given temperature is calculated. (*Ber. Berl. Chem. Ges.*, June, 1885, XVIII, 1538; *Am. J. Sci.*, November, 1885, III, XXX, 380.)

The phenomena of capillarity have received very considerable attention. Worthington has reviewed the method proposed by Quincke for determining surface tensions from the dimensions of flat drops and bubbles, and has shown that the higher results given by this method over those given by capillary tubes are due in the main to two erroneous assumptions, which may cause an error of even 10 per cent. He gives a table of the corrected values for ten liquids. (*Phil. Mag.*, July, 1885, V, XX, 51.) In a paper on the theory of pendent drops the same author shows that the value of the surface tension of a liquid may be deduced from the measurement of the value of the inclination of the tangent of the curved surface of a pendent drop to the axis, measured at a single level, that level being so chosen that the tangent is there vertical. (*Phil. Mag.*, January, 1885, V, XIX, 46; *J. Phys.*, October, 1885, II, IV, 466.)

Worthington has devised a capillary multiplier, which consists simply of a rectangular strip of platinum foil of known length rolled into a cylindrical coil, the successive convolutions being kept separate at a distance of about 2^{mm} by means of a strip of glass beads in the upper portion of the coil. The lower edges of the convolutions are in the same plane, and, as when in use, the coil hangs from one end of a balance beam, this plane is horizontal. By immersing the lower edge in any liquid and measuring by weights in the opposite scale-pan the pull on the coil the surface tension may be calculated. (*Phil. Mag.*, January, 1885, V, XIX, 43; *J. Phys.*, October, 1885, II, IV, 467.)

Rother has measured the capillary constant of several saline solutions, and also of various mixtures of these solutions. (*Wied. Ann.*, XXI, 576; *J. Phys.*, November, 1885, II, IV, 520.) The paper of Reinold and Rücker on the influence of an electric current in modifying the rate of thinning of a liquid film has appeared in full. (*Phil. Mag.*, February, 1885, V, XIX, 94.) Rücker has delivered a lecture on liquid films before the Royal Institution, giving a résumé of the investigations on this subject made by himself in conjunction with Reinold. (*Nature*, July, 1885, XXXII, 210.)

Warburg and Sachs have studied the influence of increasing density on the viscosity of liquids, and have calculated the coefficient of friction from the compressibility. This coefficient increases for carbon dioxide, ether, and benzene, and diminishes for water. This latter fact was established by Röntgen in 1881. (*Wied. Ann.*, XXII, 510, 518; *J. Phys.*, November, 1885, II, IV, 519.)

Newall has investigated the phenomena of colliding water-jets and has obtained some curious results. If two horizontal jets of water, issuing from similar glass nozzles and fed from two glass bottles, be made to collide at a small angle the jets, if tolerably clean and dust-free water be used, rebound from one another, but may be made to unite by connecting the terminals of a battery with the water in the two bottles. The surface of separation between the colliding jets is vertical and shows the colors of thin plates with remarkable brilliancy, due undoubtedly to a thin film of air, as Rayleigh has shown the two to be electrically insulated from one another. The author investigated the effect of a gradual increase of electromotive force upon these colors, and found that they remained constant until coalescence was produced, and then disappeared suddenly; thus eliminating conclusively the hypothesis that the action of electricity in promoting union may be ascribed to the additional pressure called into play by electrical attraction of the opposed water surfaces acting as plates of a condenser. (*Phil. Mag.*, July, 1885, V, xx, 31.)

3. *Of Gases.*

An interesting discussion on the kinetic theory of gases took place in the mathematical and physical section of the British Association at the Aberdeen meeting in September. The discussion was opened by Crum Brown, who stated the difficulties of the theory under two heads: First the difficulties connected with the doctrine that energy communicated from without to a gas is equally shared among the whole of the degrees of freedom of the molecules; and, second, the difficulties connected with the doctrine that energy of each kind is distributed among the molecules according to some form of the law of probability. Under the first head he called attention to the fact that the ratio of the specific heat of mercury vapor at constant pressure to that at constant volume is 5 : 3, which gives on the dynamical theory but three degrees of freedom to the molecules, and these must be the three translational freedoms. If to prevent rotation the molecules be regarded as perfectly smooth, rigid, and spherical, the radiation producing the spectrum cannot be accounted for. In diatomic gases the ratio is 7 : 5, giving three translatory and two rotational freedoms. But here again the vibration of the atoms is not accounted for, either as parts of the molecule or individually. Boltzmann's theorem asserts that the energy of a molecule is equally distributed among the different degrees of freedom. Hence, if in addition to the six degrees of freedom of a rigid body in space the molecules have twenty or thirty others, it would seem that the dynamical theory must be abandoned, as there would not be sufficient energy for translational motion. The second class of difficulties arises when it is supposed that the energy is distributed among the molecules according to some form of the law of probability. For then in a mixture of gases there would always be some molecules in a condition favorable for combination. Moreover, there should be no such sharp temperature and pressure limits for combination, such as exist between phosphorus and oxygen, for example. And further, oxygen and hydrogen may be kept for a long time at a temperature near that of combination without any union taking place. Liveing maintained that the difficulties encountered arose from the assumptions of Boltzmann's theorem, which is not a necessary part of the kinetic theory. It is quite possible that mercury vapor has no sensible vibrational energy at the temperatures at which its specific heat has been measured. The more perfect gases have at ordinary temperatures much less vibrational than translational energy; so that they may have only one or at most two modes of vibration. Sir William

Thomson had never seen any reason at all for believing in Boltzmann's theorem. J. J. Thomson said that he thought the reason that the value of the specific heats of a gas, as found by experiment, did not agree with the value given by Boltzmann's theorem was because Boltzmann's theorem was not true. Hicks stated that to him one of the greatest objections to this theorem was the difficulty in believing that the mean energy of any vibration whatever of an atom was susceptible of unlimited increase. Osborne Reynolds remarked that the kinetic theory is supposed to be true only in so far as the assumptions on which it is based represent the actual conditions. In any gas the mean energies of translation in which there is most rapid communication and no appreciable resistance will be much greater than the mean energies of vibration to which there is all the resistance consequent on the radiation and in all probability but little communication. (*Nature*, August, October, 1885, XXXII, 352, 533.)

De Romilly has modified the form of vacuum jet which he suggested in 1881, and to which he gave the name of pneole. In its original form a jet of water or of mercury was thrown upward from a circular orifice into a second and similar one placed above it, carrying the surrounding air with it. Since the interior parts of the solid column contributed nothing to the effect, the periphery alone being useful, the author has placed a solid cylinder within the jet so as to make the opening annular. The liquid is thrown up by centrifugal action. A mercury apparatus of this description, turned by hand, made a barometric vacuum in a globe of $600^{c.\,c.}$ capacity in about six minutes. (*J. Phys.*, August, 1885, II, IV, 366.)

Wilde has made a series of experiments on the velocity with which air rushes into a vacuum. Theory assumes that air rushes into a vacuum with the velocity which a heavy body would acquire by falling from the top of a homogeneous atmosphere, *i. e.*, a velocity of 1,332 feet a second. The apparatus consisted of two strong cast-iron cylinders, the smaller having a capacity of 573 cubic inches and the larger of 8,459 cubic inches. To the smaller a compression pump and pressure gauge were attached, to the larger an exhausting pump and a vacuum gauge. The air was discharged from the smaller cylinder into the large one through a disk of tinned iron 0·75 inch in diameter, and 0·01 inch thick, pierced in the center with a circular hole 0·02 inch in diameter. The vacuum was 0·6 inch mercury, and the pressure varied from 10 to 135 pounds per square inch. The maximum velocity observed was 1,225 feet per second, and this only at the commencement, the values in general being considerably less than theory indicates, though at forty atmospheres the theoretical velocity would be reached. Experiments made on the discharge of the compressed air into the atmosphere showed that the times of each discharge from 120 pounds to 15 pounds effective pressure are identical with the times of discharge from 135 pounds to 30 pounds absolute pressure into a vacuum. Hence the author formulates the general proposition that the atmosphere acts as a vacuum, and offers no resistance to the discharge of air of all pressures above two absolute atmospheres. (*Phil. Mag.*, December, 1885, V, xx, 531.)

Hoffmann has determined the law of the flow of air through a capillary tube too short for it to obey Poiseuille's law. He concludes (1) that the principal cause of the failure of this law under these circumstances is to be sought for in the perturbations produced at the two orifices, particularly at the entering one; and (2) that if the times of flow of any mass of air whatever be taken as ordinates, and the lengths of the tubes (of constant diameter) through which the air flows as abscissas, very flat curves are obtained which ascend rapidly and are intermediate between a straight line and a hyperbola. (*Wied. Ann.*, XXI, 470; *J. Phys.*, November, 1885, II, IV, 512.)

Hausemann has experimented to determine the law of the diffusion of gases through a porous partition, the gases used being oxygen and hydrogen. The diffusiometer was constructed so as to allow the diffusion to take place under considerably higher pressures, for a single gas, than had been hitherto used. From the data obtained the calculation of the diffusion-coefficient for the two gases was made without difficulty. Experiment furnished perfectly concordant numbers, but the calculation of the coefficient of reciprocal diffusion by means of these coefficients did not succeed. Values were found for this coefficient of interdiffusion which decreased with the time and the upper limit of which is considerably smaller than the coefficient measured directly by Loschmidt. Hence Stefan's theory is not confirmed; it implies the hypothesis that diffusion is effected in the vacuities of porous bodies according to the same law as in open space. But it is evident that the porous partition exerts a special action which has not been taken into consideration by Stefan. (*Wied. Ann.*, XXI, 545; *J. Phys.*, November, 1885, II, IV, 518.)

Amagat has repeated his experiments on the compressibility of air and of nitrogen with reference to the use of these gases in manometers, extending the range of pressure, which in the earlier series was never less than 20 to 30 atmospheres, down to that of 1 atmosphere. These experiments were made in one the towers of the church at Fouvières, where a clear height of 63 meters was available. The method was essentially the same as that used in the Verpilleux shaft, though with some improvements. The results agreed perfectly with previous determinations, the values for nitrogen not varying in general by one thousandth of the total pressure. But the discrepancies with Cailletet's figures still exist, amounting between 40 and 60 meters to more than 2 meters of mercury. A table is given of the product *pv* for nitrogen and air at the temperature of 16° and at pressures varying from 0·76 to 65 meters of mercury. Within these limits either of these gases may be used for filling manometers. Between 85 and 430 atmospheres nitrogen is preferable; while above 430 atmospheres hydrogen is preferable, the curve of *pv* being a straight line for this gas. (*C. R.*, XCIX, 1017; *Phil. Mag.*, February, 1885, V, XIX, 150.)

Bottomley has communicated to the Royal Society a preliminary note on the condensation of gases at the surface of glass. A quantity of non-tubular spun glass was placed in a glass tube which was then exhausted with a Sprengel pump till the exhaustion, as shown by the MacLeod gauge, was three ten-millionths of an atmosphere. At the end of an hour the vacuum remained sensibly the same, the temperature of the room being about 14°. While the mercury was flowing through for the third time the tube containing the glass was heated with a Bunsen flame. The hammering produced by the falling mercury at once ceased and the MacLeod gauge showed a considerable increase of pressure. The action of the pump was continued, and the temperature raised as high as the tube would bear in order to remove all the adhering gas. The collecting tube was then removed and the gas contained in it analyzed. The quantity was only $0{\cdot}45^{c.\,c.}$ and it consisted of carbon dioxide 8·24 per cent., oxygen 22·76 per cent., and nitrogen 69 per cent. The fibers of the spun glass were measured and found to be fairly uniform and 7·06 hundredths of a millimeter in average diameter. By comparative weighing the number of fibers in the tube was found to be 6,370. Their average length was $10{\cdot}25^{cm}$. Hence their total surface was $1{,}448^{sq.\,cm}$. In a second experiment 15,500 glass fibers were used, having a total surface of $3{,}527^{sq.\,cm}$. The gas given off measured $0{\cdot}41^{c.\,c.}$ of which 78·6 per cent. was carbon dioxide, the remainder being oxygen (10·5 per cent.) and nitrogen (89·5 per cent.). This large amount of carbon dioxide is difficult to account for unless it was taken up by the glass at the time it was spun. (*Nature*, March, 1885, XXXI, 423.)

Kayser, in a note to the Physical Society of Berlin, calls attention to Bunsen's paper explaining the discrepancies between his own results and those of Kayser regarding the absorption of carbon dioxide by glass surfaces. Bunsen has now shown that the glass threads, even after dry air had been passed over them for a long time, still retained a layer of water which was thinner the higher the temperature, but was not entirely dissipated until the temperature reached 500°. Hence the absorption observed by Bunsen, and which appeared to continue indefinitely, would seem to have been an absorption by this layer of water, whereas in Kayser's experiments, in which the glass threads had been freed from all adhering matters by boiling oil, the carbon dioxide had been absorbed by the smooth glass itself. (*Nature*, May, 1885, XXXII, 72.)

ACOUSTICS.

Neyreneuf has determined the velocity of sound in steam by a method based upon certain observations of Weber and Savart. A longitudinally vibrating reed is attached to the end of a cylindrical draw-tube 18^{mm} in diameter through which the air passes to throw it into vibration. The reed speaks or is silent for certain definite variations in the length of the draw-tube; the sum of the two consecutive intervals corresponding to sound and silence being equal to the wave length of the sound given by the reed. Any change in the velocity of the air current modifies both the intervals, but their sum remains absolutely the same. With a draw-tube which may be extended through 3 meters, a series of closely concordant measurements of the lengthening and shortening may be rapidly made, whose mean value is closely approximate. Since Biot has shown that the proper sound of a reed is independent of the nature of the gas acting upon it, it suffices simply to sound this reed with different gases in order to compare directly the velocities of sound in them, which are proportional to their wave lengths. The relative values obtained were, for air 27·5 to 32; carbon dioxide, 22·5 to 25; illuminating gas, 42, and hydrogen 113. The mean of nine closely concordant experiments gave 40·48 for the wave length in steam at 100°, the calculated value being 41·089. (*J. Phys.*, December, 1885, II, IV, 550.)

Mercadier has continued his studies on the laws of vibration of circular plates. He concludes (1) that it is not possible in practice to construct disks of iron or steel of a thickness less than one millimeter which shall give sounds calculated in advance from their dimensions; and (2) that the mathematical theory of circular vibrating plates is not affected by this, since the differences between the calculated and the experimental results are explained by circumstances difficult to introduce into formulas. In all cases the more the thickness increases the closer is the accord between theory and experiment. Hence, in verifying the theory anew, it will be necessary to experiment on disks of small radius and of sufficient thickness. (*J. Phys.*, December, 1885, II, IV, 541.)

Semmola has observed that if the conductors of an influence machine are connected by means of two wires 5 meters long with two binding screws on opposite sides of a brass plate 1 millimeter in thickness, resting on an ebonite funnel, and the path of the current is broken so that sparks strike across, the plate begins to sound. A Geissler tube or a lead wire may be interposed in the break without destroying the effect, or a wire containing the break may be led to earth from one of the binding screws. The sound is louder if the upper end of this wire is held at a short distance from the connecting post, so that sparks pass. The wires from the machine may even be connected with a second metal plate parallel to and at a distance from the other one, the sound being strengthened by connecting this plate to earth, and slightly by interposing a glass plate. If the wires be connected with the insulated wire of a sonometer, instead of the brass plate, no sound is heard unless an ebonite ear-trumpet is placed on the resonant box. (*Beiblätter Phys.*, IX, 671; *Phil. Mag.*, December, 1885, V, XX, 548.)

Le Conte Stevens has suggested an improvement in the method of projecting acoustic curves optically. He uses the well-known method of Lissajous, but instead of throwing the beam reflected from the mirror of the second fork directly on the screen, he receives it on an oscillating or revolving mirror, which sends it to the screen. If either fork vibrate alone, the curve is the simple sinusoid corresponding to its rate; while if both are put in vibration the compound curve characteristic of the interval is obtained. If the ratios are exact, the form of the curve depends on the difference of phase and is constant. If they are not exact, interference takes place and the beats are seen to have their optical expression. (*Am. J. Sci.*, March, 1885, III, XXIX, 234.)

Felici has suggested the following arrangement for showing Lissajous figures by means of vibrating strings. A piano wire, something more than a meter long, is strung horizontally in such a way that the tension can be varied at will. Upon it is fixed vertically by means of a little cement a card in which a narrow horizontal slit has been cut. Behind this wire a second similar wire is placed vertically exactly opposite the center of the slit in the card. The tension of both cords is so regulated that their vibration ratios are simple. On vibrating them both simultaneously in parallel vertical planes, so that the two vibrations are perpendicular to one another, and on throwing a beam of light through the point of intersection, the image on a screen formed by means of a lens shows the characteristic Lissajous curve in black within a bright rectangle. (*Il Nuovo Cimento*, XVI, 160; *J. Phys.*, December, 1885, II, IV, 557.)

In order to facilitate the determination of the number of beats given by a vibrating body with a fork of known pitch, Israïleff has constructed a pendulum the vibrations of which can be regulated to coincide with the beats observed. For this purpose he displaces a weight micrometrically along the rod of the pendulum, prolonged for this purpose above the axis of suspension. An empirical graduation permits direct reading of the number of vibrations to be added to or subtracted from the number of the vibrations made by the fork in order to obtain those of the sounding body. In Russia the bells in church towers are fixed and are struck by their tongues acting as hammers. To produce an agreeable effect, the bells must be so tuned that they yield exactly the harmonics of the same fundamental tone. It is for this purpose that the above device was constructed. Israïeff has himself made the tuning forks for comparison. The set begins at 440 vibrations and continues to 880, increasing regularly by 8 vibrations, tuned with great care. To lower the tone the central portions of the bell are turned off on a lathe, and to raise the tone, the peripheral portions, until the proper tone is reached. (*J. Soc. Phys.-Chim. Russe*, XVI, 1; *J. Phys.*, December 1885, II, IV, 588.)

In 1879 Mayer devised a method of measuring with great accuracy the vibration periods of tuning forks, the details of which have only now been published. It consists, first, in making the tuning fork, to which an exceedingly fine light style is attached, describe its own vibrations on a revolving cylinder covered with smoked paper; and, second, in determining the exact number of vibrations made per second by means of a spark produced between the tuning-fork style and the metal cylinder whenever contact is established in an electrical circuit by means of a seconds pendulum. This pendulum is provided with a triangular platinum point, which as it vibrates cuts a small and rigid mercury globule on an adjustable iron cup. The pendulum and mercury globule are in the primary circuit of an inductorium, the fork and cylinder in the secondary circuit. It is essential that the discharge should not be multiple, but should consist of only a single spark, a result secured by varying the strength of the current in the primary circuit and the size of the condenser in the secondary. The author used this method not only to determine the absolute pitch of tuning forks, but also to determine the absolute constancy of the pitch with decreasing amplitude, and, in conjunction with the method of beats, to study the effect of temperature on pitch. He concludes that a Koenig fork gains or loses $\frac{1}{21561}$ part of a vibratory period by a change of temperature of 1° F. The effect of the scrape of the style on the vibration of the fork was also measured and found to be —·026 vibration. The results of his determinations of the pitch of five European forks of various standards are given in the memoir, and also some results of the use of the above method as a chronoscope. (*Mem. Nat. Acad. Sci.*, 1885, III, 45.)

Ellis has given an account of the method of Mayer, and has compared the results obtained by it with those of other methods, especially those of Scheibler, of MacLeod, and of Koenig. The five forks sent to Mayer had been measured by himself with Scheibler's tonometer, and also by MacLeod. The results agreed within 0.1 vibration. Although Mayer gives his results to three decimal places, Ellis thinks that the number of varying circumstances is so great that "at most two places of decimals (perhaps only one) out of the three of Mayer's means can be trusted." Hence he doubts whether Mayer's process is superior to Scheibler's, although he concedes that it is fully equal to it. As a chronoscope, he regards it as extremely valuable, since if the time of vibration be determined to $\frac{1}{100}$ of a vibration, and the fork makes 400 vibrations per second, the measurement would be correct to $\frac{1}{40000}$ part of a second. As to the effect of temperature, MacLeod finds the coefficient to be $\frac{1}{20490}$, Koenig $\frac{1}{16112}$, and himself $\frac{1}{18280}$; while Mayer, as above stated, obtained the value $\frac{1}{21561}$. (*Nature*, November, 1885, XXXIII, 54.)

Soret has advocated the A of 432 vibrations as the standard of musical pitch. Objection seems to be raised to this suggestion, long ago made in Belgium and rejected by a commission, who adopted in March, 1885, the French A of 435 vibrations. The arguments in favor of 432 are almost entirely arithmetical. But even if practicable to make a fork exact in the arithmetical series at the start, the charm of the arithmetic vanishes with a slight change in temperature. Up to 1813 all Europe had used a pitch within a comma either way of Handel's fork A 422·5. Then the Russian Emperor gave a set of new instruments to a Vienna regiment and the pitch began to rise. In 1826 the London Philharmonic Society adopted A 433. In 1859 France adopted A 435. The English concert pitch is now based on A 454·7, the army pitch being based on A 452. (*J. Phys.*, November, 1885, II, IV, 506; *Nature*, May, 1885, XXXII, 9.)

Ellis has presented a paper to the Society of Arts on the musical scales of various nations, chiefly those of ancient Greece, Arabia, India, Java, China, and Japan, giving the results of his endeavors to discover the system by which they tuned. He concludes that there is not anything among them approaching to a single "natural" musical scale. On the contrary, the systems, where systems can be said to exist, are very diverse and often very capricious, and are always very imperfectly carried out. This arises, probably, from harmony proper being unknown, though *ensemble* playing is common. In the latter case unisons are the rule, the effect being produced by diversity of quality of tone; but certain effects are produced by admitting octaves, and rarely fourths and fifths, but no more. Also a kind of polyphony may be remarked, some instruments, especially those with tones of very short duration, being allowed to discant while the others go on with the air. The investigation must go on for years, however, before the matter can be fully decided. (*Nature*, March, 1885, XXXI, 488.)

Neesen has reported to the Physical Society of Berlin the results he had obtained in his experiments on sounding air columns, with the object of determining the relation of Kundt's dust figures to the tone-pitch. By means of an electric tuning fork, whose tone-pitch could be variously modified by varying weights, the air was maintained in permanent vibration in a glass tube closed at the bottom by a membrane. Many measurements of the intervals separating the sand ribs were made, but no relation between these values and the tone-pitch could be established. He found, moreover, that the long-known wandering of the ribs in a permanently sounding tube stood in no demonstrable relation to the vibrations of the air, being in the same tube directed in one way in one place and another way at another place. The cause of the wandering of the ribs could not be ascertained. As to their origin, observations had been made at those spots in the tube where the wanderings of the ribs issued in contrary directions, and where, consequently, there was comparative rest. A very interesting phenomenon was observed on taking the measurements of pressure in the sounding tube. A narrow glass tube, open on both sides, with an oil index, the movements of which were observed, acted as a manometer. No displacement of the index was ever noticed, but out of the interior end of the manometrical tube there appeared to issue a current of air impelling the cork sand a long way. The strength of the apparent air current might be measured by little mills, and when small radiometers with paper wings were introduced into the sounding tube they fell into very lively rotation. If, instead of full paper wings, the radiometers had small conical paper tubes, directed all alike, they rotated just as fast in just the same manner as the others. When, however, one approached a node, the rotation became slower, ceased, assumed the contrary direction in order after further progress, to pause again, and next pass into the former lively rotation. (*Nature*, November, 1885, XXXIII, 95.)

Elsass has suggested an improved form of monochord in which the vibrations of the string are produced by means of a siren. A small disk is fixed somewhat eccentrically upon the axis of an ordinary siren, and to the uprights carrying the wheelwork is attached, by means of two screws, a support for a little bent lever, the conically-pointed axis of which rests in two steel screws passing through the support. This lever is capable of motion in a vertical plane, and presses with its shorter and vertical arm against the eccentric disk while the longer and horizontal arm carries the end of a stretched thread at right angles to the axis of the lever. When the siren is at rest the tension of the thread retains the lever in position, and when it is sounding, and the eccentric disk gives it a slight periodic motion, this tension brings it back. At its other extremity the thread passes over a friction pulley, adjustable in height, and is stretched suitably by weights placed in an attached scale pan. When properly regulated and the siren put in motion, the vibrations of the thread may easily be followed by the eye; but as the velocity increases, the friction of the disk against the lever produces a noise; this suddenly ceases and the thread is seen to be in stationary vibration of the fundamental form. The amplitude is considerable, being often of three fingers' breadth for threads of a meter in length. Moreover, the thread acts as a regulator for the siren, and it is easy to maintain its pitch constant. Since the thread may be made to assume different forms of vibration with a constant tension by varying the speed of the siren, it differs from Melde's apparatus, where the rate of vibration is constant and the tension varies. The author shows how it may be used to illustrate Mersenne's laws. (*Phil. Mag.*, January, 1885, V, XIX, 48.)

HEAT.

1. *Production of Heat.—Thermometry.*

Mallard and Le Chatelier have given a résumé of their later researches undertaken under the auspices of the Fire-damp Commission, in order to determine, for a number a gaseous mixtures, the temperature of inflammation, the speed of propagation of this inflammation, and the temperature given by the combustion in close vessels. They find that inflammation of gaseous mixtures may be propagated in two distinct ways: either with a slow and uniform speed corresponding to the deflagration of explosive solids, or with a speed extremely great corresponding to the explosion of the same bodies. The only difference which exists between solid and gaseous explosives is that in the former the manner in which the inflammation is produced regulates generally the mode of combustion, flame producing deflagration and shock determining explosion; while for gaseous bodies deflagration changes spontaneously into explosion, at least for certain mixtures where the propagation is very rapid. There is, moreover, for gases a mode of vibratory propagation very variable and very irregular, which is, in a certain sense, intermediate between deflagration and explosion. These phenomena the authors explain by supposing that the slow deflagration corresponds to the propagation of the temperature of inflammation by conduction; while on the other hand the explosive wave is produced at the instant when the pressure produced by the ignited layer upon the following one is sufficient to raise this latter to the point of inflammation. From this moment the inflammation is itself propagated with the speed of transmission of this pressure, *i. e.*, with the speed of sound, accelerated, of course, by the high temperature produced. The progress of the slow wave was studied by means of photography. A glass tube containing the gaseous mixture—generally a highly photogenic mixture of carbon disulphide and oxygen, or nitrogen dioxide—was placed near a revolving cylinder and parallel to its axis. As the flame progressed along the tube it developed a curve on the sensitive paper with which the cylinder was covered, the abscissas of which gave the place of the flame and the ordinates the time required for it to reach this point. The displacement of the flame along the tube is perfectly uniform and constant for the same mixture, being for one volume carbon disulphide vapor and three of nitrogen dioxide 1·25 meters per second. The temperatures of combustion are given in tabular form. (*J. Phys.*. February, 1885, II, IV, 59.)

In their researches on the speed of the explosive wave in gases, Berthelot and Vieille have shown that this wave is propagated with a speed approximately equal to the mean speed of translation of the molecules of the gaseous products of combustion, upon the hypothesis that all the heat involved in the reaction is found for the first instant in the compounds formed. Thus, for electrolytic gas, the mean of several determinations gave a speed of 2,810 meters per second, the mean speed of molecular translation for the vapor formed being 2,831 meters. But this law did not appear to hold for mixtures of carbon monoxide with oxygen or with nitrogen monoxide. Dixon has now pointed out the fact that water-vapor is necessary to the combustion of carbon monoxide, and has shown that as the proportion of vapor augments the speed of inflammation increases also. From experiments made in a lead tube 55 meters long and 13 millimeters in diameter, he found the speed of the explosive wave to be 2,817 meters at 10° C., confirming the above results. With carbon monoxide and oxygen nearly dry, the explosive wave was not established until the flame had traversed a distance of 700 millimeters from the firing point. The speed observed was rather over 1,500 meters per second. After the explosion a fine layer of carbon as found to cover the inside of the tube, showing that the enormous temperature reached in the explosion had decomposed the carbon monoxide into its constituent elements. (*Proc. Brit. Assoc.* 1884, 688; *J. Phys.*, October, 1885, II, IV, 472.)

Sherman has investigated the fact that when a thermometer is heated above a certain point the mercury column is permanently displaced with regard to the scale. This point of temperature varies with the glass of which the bulb is made and also with the previous use of the thermometer. The range, in his experience, is between 110° and 255°, the former for German and American soda-lime glass, the latter for English flint and French crystal. By much use or long heating the displacement frequently reaches 10° and may amount to 26°. The author now finds that if the thermometer be exposed to a high temperature for some hours the displacement of the zero point becomes less and less with each successive treatment, so that the curve representing the elevation becomes more nearly parallel with the axis of abscissas, which represents the hours of heating. Moreover, the thermometer after treatment no longer shows this rise in zero point on heating and is found to repeat its readings accurately when exposed to similar conditions. Hence the author concludes that after such treatment the thermometer is as serviceable as a measurer of temperatures ranging from 0° to 300° as the accustomed standard is for the range 0° to 100°. These changes are accompanied by a change in the expansion-coefficient of the glass, due perhaps to a partial separation of the crystalline from the amorphous constituents of the bulb glass. (*Am. J. Sci.*, July, 1885, III, XXX, 42.)

Wroblewski has compared the indications of a hydrogen thermometer with those of a thermo-electric junction. The former indicates below —193° temperatures lower than the latter, thus showing a greater contraction at this temperature than the laws of Boyle and Charles require. Moreover the departure increases as the temperature diminishes. The hydrogen thermometer gives —207° for the temperature of solidification of carbon monoxide and — 214° for that of nitrogen, while the thermo-electric junction gives — 199° and —203°. The thermo-electric curve is remarkably regular, and hence it follows that the thermo-electric junction is a more reliable indicator of temperature than the air thermometer at these low points. When oxygen, nitrogen, and carbon monoxide are evaporated in a vacuum the temperature falls only a few degrees below —200°. (*C. R.*, April, 1885, C, 979; *Am. J. Sci.*, June, 1885, III, XXIX, 495.)

Mendenhall has described a differential-resistance thermometer for the ready determination of temperature at a distant point. It consists essentially of a thermometer of large size the stem of which has an internal diameter of about a millimeter, and the bulb of which is so large that a difference of 1° gives a displacement of 5^{mm} in the column. Running down through the stem is a platinum wire, about $\cdot 08^{mm}$ in diameter, terminating in the bulb, which has a somewhat heavier wire sealed into it. The resistance between the upper and lower ends of the thermometer will depend largely on the length of the exposed platinum wire, and this upon the temperature; so that as the temperature rises the resistance in circuit is diminished by an amount equal to the difference between that of the platinum wire which disappears and that of the mercury which takes its place less the increase in the resistance of the wire and mercury due to increase of temperature. From the equation representing this change in resistance as a function of the temperature a curve is constructed from which the temperature corresponding to any given resistance may easily be read. The resistance is measured on a Wheatstone's bridge, the telephone being conveniently substituted for the galvanometer for ordinary work. (*Am. J. Sci.*, August, 1885, III, xxx, 114.)

Angström's geothermometer consists of an ordinary instrument whose bulb is placed in an iron vessel containing mercury sunk to the required depth. The stem is open above and in it hangs a metallic wire moved at the surface of the ground by means of a rack and pinion. So soon as the wire touches the mercury an electric circuit is closed, and this, by means of an electro-magnet, arrests the pinion. The stem carries a graduated scale previously calibrated, so that a simple inspection gives the temperature at once. No correction for temperature is necessary, since the parts are compensated. (*J. Phys.*, January, 1885, II, IV, 46.)

Whipple has communicated to the London Physical Society a description of the process followed at Kew for testing thermometers at or near the melting point of mercury. About 20 pounds of mercury are poured into a wooden bowl and frozen by carbon dioxide-snow and ether. The mercury is stirred with a wooden stirrer and the snow is added till the experimenter feels, by the resistance to stirring, that the mercury is freezing. By continuing the stirring for some time the mercury becoms a granular instead of a solid mass. The thermometers are then inserted together with a standard and compared. About one hundred mercury or forty spirit thermometers can be thus examined in half an hour, using about 200 gallons of carbon dioxide gas compressed to form the snow. The bowl, ether, and mercury are cooled first to —10° by an ordinary freezing mixture. The average correction at the melting point of mercury is now less than 1° F. When the process was introduced, in 1872, it amounted to 5°, but has steadily decreased. (*Nature*, November, 1885, XXXIII, 93.)

2. *Expansion and Change of State.*

Madan, doubting the statement generally made that stretched india-rubber forms an exception to the general law of expansion by heat, has called attention to Russner's investigations on this subject made in 1882. He finds (1) that india-rubber always has a definite and positive coeffi cient of expansion, the value of which at 10° was found to be 0·000657 and at 30° 0·000670; (2) that india-rubber in a stretched state expands to the same extent as when not stretched, no point of minimum density existing; (3) that the apparently anomalous behavior of stretched rubber is a case entirely analogous to that of anisotropic crystals which expand differently in different directions; Iceland spar, as Mitscherlich showed, contracting by heat in a direction perpendicular to the principal axis, though its volume as a whole increases. Moreover, when stretched, ordinary rubber becomes anisotropic and gives color between two crossed Nicol prisms, the direction of the strain lying at 45° with the plane of polarization. (*Nature*, October, 1885, XXXII, 625.)

In a subsequent note, Tomlinson agrees with Schmulewitsch that the effect of heating a stretched piece of rubber is to lengthen it if the tension is small, and to shorten it if the tension is large; so that for a certain tension there will be neither elongation nor contraction. Moreover, Tomlinson concludes from his experiments that the critical tension will be lower the higher the temperature. (*Vierteljahrschr. Nat. Ges. Zürich*, XI, 202; *Nature*, November, 1885, XXXIII, 7.)

Gernez has continued his researches upon the changes in the crystalline form of sulphur produced by heat. He finds that while the octohedric form may be preserved at all temperatures below its fusing point, yet that at 97·6° and above if touched with a fragment of prismatic sulphur, it is transformed into the prismatic variety. To this state of unstable equilibrium he gives the name crystalline surheating. On the other hand, the change of prismatic into octohedral sulphur with decreasing temperatures, shows a retardation analogous to that above mentioned, to which the author, following Mallard, gives the name crystalline surfusion. The conditions affecting these uncertain states he has now investigated, and has concluded: 1st, that the speed of devitrification is not greater as the temperature is lower, there being always an intermediate temperature of maximum rapidity of change; 2d, that the crystalline form is not always sufficient of itself to identify the variety, since considerable differences exist in pieces having the same form; 3d, that the action of heat upon liquid sulphur at a constant temperature produces a change which increases with time and continues even after solidification; 4th, that liquid sulphur heated from a given temperature and then cooled again to the same temperature undergoes a modification manifested by change of properties, which continue even after solidification; 5th, that octohedral sulphur, melted, solidified in the prismatic form, and then changed to the octohedral form, has not recovered its primitive properties, and does not even after many months exposure to the ordinary temperature. (*J. Phys.*, August, 1885, II, IV, 349.)

Raoult has continued his investigations on the action of dissolved substances in lowering the freezing point of solutions. His results show, 1st, that if in the solution of an alkali salt containing one equivalent of the salt in 100$^{c.c.}$ of water, the monad metal be replaced by an equivalent quantity of a dyad or polyad metal, the depression of the freezing point is diminished by a quantity sensibly constant and equal to 10·5; and, 2d, with regard to acids, that if in the solution of a salt of a strong monobasic acid, containing one equivalent of the acid in 100$^{c.c.}$ of water, the monobasic acid be replaced by an equivalent quantity of a strong dibasic acid a diminution of the depression of the freezing point is observed which is nearly constant and approaches 14. From the partial depression values given in the paper, the molecular depression produced by any salt may be calculated from its molecular weight. (*Ann. Chim. Phys.*, VI, IV, 401; *Am. J. Sci.*, May, 1885, III, XXIX, 399.)

Bouty has suggested the hypothesis that the molecular latent heats of all bodies measured at their normal temperatures of ebullition are proportional to the squares of these temperatures. This assumes (1) that the normal density of saturated vapors corresponds to half their molecular weights; and (2) that Dalton's law is rigorously true. To test the question he gives a table of values obtained from seventeen organic bodies, chiefly alcohols and ethers, in which the quotient of the molecular latent heat by the square of the absolute ebullition temperature is nearly constant. For water the value is 0·0694; for the alcohols, 0·0730; for aldehyde, 0·0695; for the haloid ethyl ethers, 0·0691; and for compound ethers, 0·0735. (*J. Phys.*, January, 1885, II, IV, 26.)

On theoretical grounds J. Thomson had reached the conclusion that the maximum elastic force of a vapor in contact with its liquid is greater than the maximum elastic force of a vapor in contact with the corresponding solid, contrary to the opinion of Regnault, who held them to be the same. Ramsay and Young have now verified experimentally this conclusion of Thomson's. Their experiments were made partly in barometer tubes, partly in an apparatus specially constructed for the purpose. They plotted the curves representing the variation of the elastic force with the temperature for camphor, benzene, glacial acetic acid, and water, and noticed that the curves where these bodies were in the solid state did not coincide with those where they were liquids, the deviation being in the direction predicted by Thomson. The authors regard the result as general, and applicable in all cases. (*Proc. Roy. Soc.*, XXXVI, 499; *J. Phys.*, February, 1885, II, IV, 91.)

Müller-Erzbach has suggested a new method for determining the elastic force of the vapor of water in hydrated salts, which consists in determining simultaneously the loss of weight which two identical tubes suffer, one of which contains water the other the hydrated salt, in an atmosphere dried by means of sulphuric acid. The ratio of loss of weight the author regards as rigorously equal to the ratio of the elastic forces of the vapor of water in the two tubes. In this way he finds that the evaporation from hydrated salts in completely dry air gives constant dissociation tensions. From the variations of these tensions, the existence of three hydrates of sodium phosphate is inferred, corresponding, respectively, to two, seven, and twelve molecules of water; of two hydrates of sodium borate, with five and ten molecules of water; of two hydrates of sodium carbonate, with one and ten molecules; while in sodium sulphate all the combined water constitutes only a single hydrate. (*Wied. Ann.*, XXIII, 607; *J. Phys.*, November, 1885, II, IV, 521.)

Klobukow has contrived two new forms of apparatus for measuring vapor densities, the one for substances of low the other for substances of high boiling point. The latter, which is the more novel, has the form of an areometer of constant volume, containing a cavity for the vapor, the volume being deduced from the weight required to restore the level. The areometer is floated in mercury, the temperature of which is raised so as to volatilize the substance used. (*Wied. Ann.*, XXII, 493; *J. Phys.*, April, 1885, II, IV, 177, 179.)

In consequence of the very considerable loss in preparing solid carbon dioxide, Cailletet proposes the use of a hollow cylinder closed at bottom, and having a cover attached by a bayonet catch, through which cover an inclined tube passes to within a few millimeters of the bottom of the cylinder. Through the middle of the base a larger tube passes which serves for a handle and also for the escape of the gas. It rises nearly to the top of the box and is perforated with holes. The whole apparatus is made of vulcanite. Experiments show that 65 grams of snow are obtainable from 200 grams of the liquid carbon dioxide blown in through the inclined tube. (*J. Phys.*, March, 1885, II, IV, 122.)

Cailletet has succeeded in obtaining by the use of liquid ethylene a temperature sufficiently low to liquefy oxygen completely. The complete apparatus, constructed by Ducretet, is so well arranged that the production of liquid oxygen is an easy lecture-room experiment. The steel cylinder containing the liquid ethylene is supported with its axis vertical, its mouth being downward. To this a copper worm 3^{mm} or 4^{mm} in diameter is attached, closed at the lower end by a screw plug. On cooling this worm to $-70°$ in a bath of methyl chloride, the ethylene within it has only a feeble tension and flows out without much loss when the screw plug is opened. The liquid ethylene is received in a narrow tube of thin glass placed within a larger vessel containing dry air. It is necessary now only to accelerate its evaporation by passing through it a rapid current of air or hydrogen, also cooled in the methyl chloride bath, in order to see the oxygen compressed in a glass tube immersed in the ethylene condense into a clear colorless liquid having a sharply-defined meniscus. A hydrogen thermometer showed the temperature of the ethylene to be $-123°$. (*C. R.*, C, 1033; *J. Phys.*, July, 1885, II, IV, 293; *Nature*, October, 1885, XXXII, 584; *Am. J. Sci.*, July, 1885, III, XXX, 73.)

Olszewski has measured the density and the expansion coefficient of liquid oxygen. A small reservoir of glass 1·4 c. c. in capacity was filled with liquid oxygen, cooled to $-139°$ by the evaporation of liquid ethylene and maintained at a pressure of 40 atmospheres. The oxygen was then allowed to resume the gaseous state and from the volume of this latter its weight was calculated. The density thus obtained was 0·8787 at − 139·13°. The expansion coefficient was 0·01706. Moreover the author finds that liquefied chlorine congeals at −102° and that hydrogen chloride is solid at −115·7° and fuses again at −112·3°. Hydrogen arsenide freezes at −118·9° and melts at −113·5°. Silicon fluoride is solid at −102°. Ethyl ether freezes at −129°. Methyl alcohol has the consistence of oil at −102° and of butter at −115°; it then passes gradually into the solid state, which is reached at −134°. (*Ber. Ak. Wien*, 1884, 72; *J. Phys.*, April, 1885, II, IV, 184.)

Wroblewski has described in detail the apparatus which he uses for the liquefaction of gases and has given the results of his comparisons of the hydrogen thermometer with the thermo-electric couple. The critical temperatures for nitrogen, carbon dioxide, and oxygen he finds to be −145°, −141°, and −118°, respectively; and the critical pressures 33·6, 35, and 50 atmospheres. The boiling points under a pressure of 740^{mm}, are −193°, −190°, and −181·5° The lowest temperatures which he has observed are − 200·4° for oxygen under a pressure of 2^{cm}, −206° for nitrogen at $4{\cdot}2^{cm}$, and for carbon monoxide −201·6° at 4^{cm}. Both nitrogen and carbon monoxide solidify at these temperatures. (*Ber. Ak. Wien*, March, 1885; *J. Phys.*, July, 1885, II, IV, 316.)

In hygrometry several papers have appeared. Hazen has studied the psychrometer and has compared its indications with those of the condensing hygrometer. (*Am. J. Sci.*, December, 1885, III, XXX, 435.)

Bourbouze has suggested two new modifications of the hygrometer. One of these is based on the production of the colored rings seen round a source of light when viewed through a glass plate on which vapor begins to condense. A small rectangular tube has holes on opposite faces closed by very thin glass plates. A very sensitive thermometer is used, dipping only very slightly into the liquid. On causing a current of air over the liquid surface, either by aspiration or otherwise, the whole is cooled and dew is deposited on the glass. By placing the apparatus between the eye and a luminous point these concentric rings are readily observed and the temperature noted. The other instrument is similar but has a metallic envelope, the temperature of which is determined by the thermometer. (*J. Phys.*, September, 1885, II, IV, 425; *Phil. Mag.*, August, 1885, V, XX, 220.)

Sire has also suggested two new types of condensing hygrometers, in both of which the deposit of dew is observed on a cylindrical or plane brilliant surface. The reservoir in the first type is a cylindrical tube of thin polished metal, the ends of which are insulated in the interior by two pieces of ebonite, so that the volatile liquid is in contact with the metal only over a middle zone a centimeter broad. In the second the reservoir is entirely of ebonite, traversed laterally by a circular aperture closed by a thin metal disk, polished on the inside. The surfaces are metallic palladium. (*Phil. Mag.*, November, 1885, V, XX, 468.)

3. *Conduction and Radiation.—Specific Heat.*

Stenger has measured the conductibility of tourmaline by the method of Weber, employing for this purpose plates whose homogeneity had been thoroughly established. He was unable to discover the least trace of unilateral conductivity and therefore supposes that the contrary results obtained by Thompson and Lodge arose from the non-homogeneity of the tourmaline they used. In consequence the author does not consider as established their theory of the pyroelectricity of tourmaline, based upon such conductivity. (*Wied. Ann.*, XXII, 522; *J. Phys.*, November, 1885, II, IV, 522.)

From the electromagnetic theory of light Maxwell deduced the proposition that a beam of light or heat falling normally on a surface exerts upon it a pressure equal to the energy which exists in unit of volume of the ether in consequence of its light-motion. Boltzmann, combining with this a relation deduced by him from the second law of thermodynamics, has obtained the law of Stefan, that the radiation from a heated body is proportional to the fourth power of the absolute temperature. (*Wied. Ann.*, XXII, 291; *J. Phys.*, November, 1885, II, IV, 526).

Schneebeli has called attention to a paper by Svanberg, published in 1851, in which is a description of an apparatus based on the same principle as the bolometer of Langley. With this apparatus he has measured the coefficient of absorption of glass, and finds for it a value which varies inversely as the temperature, being 2·4 at 100°, 1·47 at 250°, and 0·42 at 1,000°. He has also verified the law of Stefan between 400° and 1,000°, and has shown that the ratio of the luminous to the total radiation of a Swan lamp increases rapidly with the temperature; but that the ratio of this radiation to the square of the current-strength remains constant, as Joule's law requires. (*Wied. Ann.*, XXII, 430; *J. Phys.*, November, 1885, II, IV, 527.)

Bottomley, on the contrary, has obtained experimental results entirely disagreeing with Stefan's law. A current of known strength is passed through a platinum wire, the temperature of which is deduced from its increase in resistance. When the temperature has become constant, the heat generated by the current must be equal to that radiated from the surface of the wire plus that lost at the ends of the wire by conduction. The wire was placed in a high vacuum, one twenty-millionth of an atmosphere, made in a glass tube 6^{mm} in internal diameter. The wire itself was $0·4^{mm}$ diameter and about half a meter long, and was sealed into the ends of the tube, the exhaustion being effected through a lateral tube. The temperature of the room at the time of the experiment was 15°. In four experiments, the absolute temperature of the wire being 298, 383, 798, and 823, the ratio of the energy radiated was found to be 1, 6·1, 71.9, and 90·2; whereas by the law of Stefan the values should have been 1, 16, 438·8, and 499·8. (*Nature*, November, 1885, XXXIII, 85.)

The emissive power of a surface increases markedly when it is depolished. This fact Christiansen accounted for on the theory that such a surface sent out not only the heat emitted directly but also the heat emitted and then reflected. To test this theory he constructed a cube one face of which was plane, another corrugated, the corrugations having sharp angles and the sides inclined 90° to each other, a third similarly corrugated but with the inclination 45°, and a fourth containing a large number of conical cavities. All these surfaces were equally polished and their emissive powers normal to the faces of the cube were 1, 2·05, 2·66, and 8·7, respectively. The apparent emissive power of the conical cavities is approximately the same as that of a surface equal to the sum of their bases covered with lampblack. (*Wied. Ann.*, XXI, 364; *J. Phys.*, November, 1885, II, IV, 528.)

Röntgen appears to have settled the disputed question of the absorption of heat by the vapor of water by the following neat experiment: A thick tube of brass, gilded, is closed at one end by a plate of rock salt. If now it be exposed to a source of heat, the heating will depend (1) upon the heat transmitted by the walls of the tube and (2) upon the heat absorbed by the gas. Place the interior of the tube in communication with a Marey's manometric capsule, the style of which rests on the surface of a recording cylinder. Under the above circumstances it will record an increase of pressure which will be permanent if the heating is due to the first cause and transient if due to the second. The second effect is observed when the tube contains air saturated at zero and then heated to 26°, the increase of pressure due to the heating of the gas being $2{\cdot}18^{mm}$. A much less increase was observed with air containing carbon dioxide in the normal proportion of the atmosphere. The source of heat in these cases was a Bunsen burner. (*Wied. Ann.*, XXIII, 1, 259; *J. Phys.*, April, 1885, II, IV, 181, 529.)

Clark has devised a radiant energy recorder depending on the evaporation of water in vacuo. The instrument is essentially a Wollaston cryophorus in which the vertical tube and lower bulb are replaced by a simple glass tube graduated in cubic centimeters. The bulb containing the water to be evaporated is blackened by holding it in the smoke of burning camphor and is then exposed to the sun, the rest of the apparatus being silvered or properly protected by sheets of bright tin. At sunset the water which has distilled over can be read off on the graduated tube and expressed in heat-units. (*Nature*, July, 1885, XXXII, 233.)

According to Lommel's theory of fluorescence there should be an absorption band in the spectrum of esculin in the vicinity of the line A. Wesendonck has examined this part of the spectrum by means of phosphorographs and has been unable to recognize any such band in that region. (*Wied. Ann.*, XXIII, 548; *J. Phys.*, November, 1885, II, IV, 533.)

Velten has measured the specific heat of water at ordinary temperatures, using (1) the method of mixtures and (2) an ice calorimeter. The results are quite complex but the formula which appears to the author to represent best the results is of the form $k_t = 1 + \alpha t + \beta t^2 + \gamma t^3$, in which $\frac{1}{2}\alpha = -0{\cdot}0007312756$, $\frac{1}{3}\beta = +0{\cdot}0000079327$, and $\frac{1}{4}\gamma = -0{\cdot}00000002679$, k_t being the true specific heat at t_0. This indicates that the specific heat of water has a minimum value at 43.5° and a maximum at 104.5°. (*Wied. Ann.*, XXI, 31; *J. Phys.*, November, 1885, II, IV, 521.)

Berthelot and Vieille, in their studies on the heat relations of the explosion of gaseous mixtures, have been able from the data obtained to calculate the specific heat of the elementary gases, of water and of carbon dioxide at high temperatures. Thus, for the simple gases N_2, H_2, and O_2, as well as the compound gas CO, which is closely related to them, the specific heat at 2,800° is 6·7; at 3,200°, 7·9; at 4,000°, 8·4; and at 4,400°, 9·3. It will be observed that it increases rapidly with the temperature, being doubled, nearly, between 0° and 4,500°. The mean specific heat of water between 0° and 2,180° is 15·57, and between 0° and 3,240°, 18·12. Hence the mean specific heat between 130° and 230° is more than doubled at 2,000° and tripled at 4,000°. For carbon dioxide the mean value between 0° and 2,900° is 20·5, and for cyanogen, between 0° and 4,300°, 22·5. The specific heat of the former gas more than triples and the elementary specific heat quadruples between 0° and 4,300°. (*Ann. Chim. Phys.*, January, 1885, VI, IV, 66, 74; *Am. J. Sci.*, April, 1885, III, XXIX, 331.)

Bartoli has described a simple form of apparatus for lecture demonstration to show the equivalence of heat and work. Two small globes, one containing mercury, the other benzene, are connected by a narrow tube, from which rises perpendicularly a thermometer tube, graduated. On placing the mercury globe vertically above the other, the mercury flows through the tube into the lower globe, the energy of its fall being converted into heat, which expands the benzene by an amount easily read off on the fine tube. The calibration of this tube may be effected by passing a known current through a wire of known resistance sealed in one of the balloons, and calculating the heat evolved. (*Il Nuovo Cimento*, XV, 18; *J. Phys.*, December, 1885, II, IV, 558.)

Webster has experimented to determine the mechanical equivalent of heat by observing the thermal effect produced by the electric current on a thin ribbon of steel, the temperature being measured from the change in resistance. The final value obtained was $4{\cdot}14 \times 10^7$ ergs per gram-degree. (*Proc. Am. Acad.*, May, 1885; *Phil. Mag.*, August, 1885, V, XX, 217.)

LIGHT.

1. *Production and Velocity.*

The following is the conclusion reached by De Volson Wood after an extended discussion of the properties of the luminiferous æther as deduced from the best obtainable data: "We conclude then that a medium whose density is such that a volume of it equal to about twenty volumes of the earth would weigh 1 pound, and whose tension is such that the pressure on a square mile would be about 1 pound, and whose specific heat is such that it would require as much heat to raise the temperature of 1 pound of it 1° F. as it would to raise about 2,300,000,000 tons of water the same amount, will satisfy the requirements of nature in being able to transmit a wave of light or heat 186,300 miles per second and transmit 133 foot-pounds of heat energy from the sun to the earth each second per square foot of surface normally exposed, and also be everywhere practically non-resisting and sensibly uniform in temperature, density, and elasticity. This medium we call the luminiferous æther." (*Phil. Mag.*, November, 1885, V, XX, 389.)

Fitzgerald has described some mechanical models to illustrate certain properties of the æther. The elements consist of pairs of wheels so geared together that when one rotates it causes the other to rotate in the same direction. For a one-dimensional model a band suffices to connect them. By fixing a number of wheels with their axes parallel and at right angles to a plane and connecting each wheel with its neighbors by elastic bands we shall have such a model which represents a non-conducting region of the ether. A perfectly conducting region is one in which there are no bands, and a partially conducting region would be represented by the bands slipping more or less. By means of such a model the author discusses electrostatic, electrokinetic, and luminiferous phenomena, preliminary to a description of the tridimensional model, which is the object of his paper. (*Phil. Mag.*, June, 1885, V, XIX, 438.)

Trowbridge has experimented to produce, by means of an electric current, a standard of light which shall be always the same under the same conditions. His first experiments were made with platinum, a strip of foil 5^{cm} long, 5^{mm} wide, and $0{\cdot}02^{mm}$ thick being placed in the shunt circuit of a small Gramme machine, and inclosed in a Ritchie photometer box for comparison with a standard candle, the current being measured with a tangent galvanometer, and the difference of potential at the ends of the strip with a quadrant electrometer. With a variation of electromotive force of 2·6 to 3·8 volts and of resistance from 0·44 to 0·47 ohm, the current varied from 6 to 8 amperes, and the light from a very dull red up to the color of a candle. Next a thermal junction was inclosed in an Edison incandescent lamp to see if the heat radiation was proportional to the incandescence, but the thermo-electric force developed was too feeble. A loop of fine platinum wire was then inserted between the terminals of the carbon in an Edison lamp and made one side of a Wheatstone bridge, a similar wire forming a second side, thus constituting a bolometer. With an increase of resistance of the inside loop of 0·2 ohm, there was an increase of light from 3 to 7·5 candles. Though sensitive, this arrangement does not enable rays of different refrangibility to be distinguished. Experiments were then made to determine the practicability of using a thermopile to measure the amount of radiation from an incandescent strip of platinum at a fixed distance, and thus determine the total energy radiated, the light energy being simultaneously determined by comparison with a standard candle. The heat indications were found to be far more sensitive than those of the photometer. Hence he suggests as a standard of light an incandescent strip which radiates a definite amount of energy, this energy being measured at a fixed distance which will best agree numerically with the absolute system. (*Am. J. Sci.*, August, 1885, III, XXX, 128.)

Frederick Siemens has devised an important improvement in gas lighting, based on the adoption of the well-known regenerative principle. In his opinion rooms should be lighted by means of indirect rays or diffused light only, the source of light itself not being directly visible. His lamp consists of four approximately spherical and concentric hoods of sheet-iron or other suitable material so arranged that the products of combustion travel downward between the second and third and upward between the third and fourth or outer one, while the air to be heated for feeding the flame passes upward between the first and second and through the first, filling this hood with very hot air. The products of combustion pass through an opening in the top of the outer hood into a chimney. The concave surface of the first or lower hood acts as a reflector, and in its focus are placed one or more fish-tail burners of the usual type. The gas is therefore burned in a highly heated air, the temperature of which increases with that of the gas flames, the brilliancy of the light increasing in the same ratio. Tests with this lamp showed that the same burners burning the same amount of gas in the two cases gave an average of 2·875 candles per cubic foot of gas consumed when removed from the hoods and 7·74 candles per cubic foot when burned in their proper place in the lamp. (*Nature*, July, 1885, XXXII, 247.)

Wolf has proposed another modification in the well-known Foucault's apparatus for the velocity of light. His apparatus consists of two mirrors, one fixed, having a diameter of 0·2 meter, the other movable 5 centimeters in diameter. Both are concave and spherical and have the same radius of curvature. 5 meters. The source of light is a narrow aperture cut in the silver in the center of the large mirror. The pencil emanating from it and entirely covering the rotating mirror is reflected by the latter and returns to form on the surface of the fixed mirror a movable image of the aperture and of the same size. This is reflected back to the revolving mirror, and by this the Foucault image is formed. If now the mirror be rotated with sufficient speed there will be formed on the fixed mirror a series of equal luminous lines separated by equal intervals, which will continue to increase their distance from each other as the speed rises. These are Foucault images formed by multiple reflections, and the higher the image which can be measured the higher the multiple of the Foucault deviation. The author is in hopes of measuring the twentieth image, which would give a displacement of 35^{mm}. (*C. R.*, February, 1885, C, 303; *Nature*, April, 1885, XXXI, 517.)

Michelson has published a note objecting to Wolf's assumption that the image in his experiments was ill defined, and criticising in several particulars the new method. (*Nature*, May, 1885, XXXII, 6.)

Some years ago Cornu experimentally established the fact that in quartz the mean speed of propagation of the inverse circular waves along the optic axis is sensibly equal to the velocity of the ordinary wave perpendicular to this axis. Exner has now shown that a more general law can be deduced from the formulas given by Cauchy and Von Lang to represent the properties of quartz, as follows: For any direction whatever the arithmetical mean of the two velocities of propagation is equal to the arithmetical mean of the velocities which would correspond to this same direction if the medium did not possess rotatory power. Von Lang's recent measures confirm this law completely. (*Wied. Ann.*, XXV, 141; *J. Phys.*, October, 1885, II, IV, 468.)

Langley has determined photometrically the amount of light transmitted by wire gauze screens, such as are sometimes used to diminish the apparant brightness of stars in making meridian observations. He found that one screen transmitted 0.395, two screens 0·144, and three screens 0·052 of the incident light. In fact, however, the three screens as used with the telescope allowed a transmission of only 0·0014. On investigation this result was found to be due to diffraction. Hence the author concludes, first, that the transmission as measured by the photometer box was equal to the ratio of the sum of the areas of the apertures of the screen to its total area and, therefore, could be considered to be the true transmission of the screen; second, that the much smaller transmission of the screen when used in front of the object glass of a telescope to diminish the apparent brightness of a star is satisfactorily accounted for by the loss of light caused by diffraction under these circumstances; and, third, that screens used for this purpose should have their constants determined by special experiments of the nature of those now described and that their photometric use should then be limited to the reduction of the light of bodies possessing a small angular magnitude. (*Am. J. Sci.*, September, 1885, III, XXX, 210.)

Fol and Sarasin have investigated the depth to which light penetrates the Mediterranean Sea. By means of photographic plates they have proved that in the middle of a sunny day in March the rays of the sun do not penetrate below 400 meters from the surface. At 380 meters shortly before 11 A. M., the impression on the plate was less than that which would have been left on exposure to the air on a clear night without a moon. In the lake of Geneva the extreme winter limit is 200 meters; but they find as much light at 380 meters in the Mediterranean as at 192 meters in the lake. The light penetrates 20 to 30 meters deeper in the lake in March than in September. (*Phil. Mag.*, January, 1885, V, XIX, 70; *Nature*, June, 1885, XXXII, 132.)

2. *Reflection and Refraction.*

Amagat has described an instrument for measuring angles which resembles the sextant, but which has the axis of the telescope perpendicular to the fixed mirror and the movable mirror so arranged that its axis of rotation coincides with one of its edges and cuts the optical axis. The secondary mirror, instead of being fixed, is movable about an axis parallel to the plane of the graduation and perpendicular to the optic axis. Under these conditions the image twice reflected from any given point will be displaced in a plane perpendicular to that of the circle when the secondary mirror turns about its axis. If the telescope be suppressed and a simple vertical slit be placed between the eye and the axis of rotation of the movable mirror, and if the mirror be silvered all over, an object can be seen above or below it, and it can be made to coincide with the image of another object twice reflected and thus their angular distance determined, projected on the horizon. (*C. R.*, April, 1885, C, 1120; *Phil. Mag.*, June, 1885, V, XIX, 516.)

Krüss has investigated the influence of temperature on the refraction of prisms in order to determine its comparative importance in spectrum measurements. His measurements were made by means of a micrometer which moved the observing telescope in connection with an eyepiece micrometer carried by it. Three prisms were measured at different temperatures. From the results it appears that all spectrum lines shift by rise of temperature. In glass prisms this shifting is toward the violet; in quartz prisms toward the red. In the triple glass prism a change of temperature of about 5° suffices to alter the measurement of wave-length by an amount equal to the distance between the D lines. Moreover this shifting increases with the refrangibility of the region examined. (*Ber. Berl. Chem. Ges.*, December, 1884, XVII, 2732; *Am. J. Sci.*, March, 1885, III, XXIX, 251.)

Christiansen's original experiment consists in immersing glass powder in a mixture of carbon disulphide and benzene in such proportions that for one part of the spectrum the indices of the solid and of the fluid are the same. (*Wied. Ann.*, XXIII, 298.) Rayleigh has improved this experiment by using a flat-sided bottle to contain the preparation, and by having the same kind of glass for the bottle and for the powder. The sides of the bottle are worked flat, like plate glass. Ordinary flint does not seem to work as well as plate glass, though optical flint answers well. It is more important that the powder should be homogeneous in itself than that it should correspond very accurately with the glass of the bottle. Properly arranged rays lying within a very narrow range of refrangibility traverse the mixture freely, but the neighboring rays are scattered laterally much as in passing ground glass. Two complementary colors are therefore exhibited, one by direct the other by oblique light. In order to see these to advantage there should not be too much diffused illumination, otherwise the directly transmitted monochromatic light is liable to be greatly diluted. (*Phil. Mag.*, October, 1885, V, XX, 358.)

Some years ago Rayleigh examined the effect upon definition of small disturbances in the wave surfaces from their proper forms, and concluded that the aberration of a plano-convex lens focusing parallel rays of homogeneous light is unimportant so long as the fourth power of the angular semi-aperture does not exceed the ratio of the wave length to the focal distance; a condition satisfied by a lens of 3 feet focus provided that the aperture be less than 2 inches. He has now discussed the accuracy of focus necessary for sensibly perfect definition, and has reached the result that a displacement from the true focus will not impair definition, provided it is less than the product of the wave length by the square of the ratio of the focal length to the semi-aperture. Hence the linear accuracy required is the same whatever the absolute aperture of the object glass may be, provided that the ratio of aperture to focal length be preserved. Experimental results confirmed closely this theoretical conclusion. (*Phil. Mag.*, October, 1885, V, XX, 354.)

D'Ocagne has shown that if the two sides of a square and the diagonal be divided into the same number of equal parts, and a straight line be drawn from the point on one side corresponding numerically to one of the conjugate focal distances through the number of the division on the diagonal representing the principal focal length, this line will cut the other side at a point representing numerically the other conjugate focal distance. Conversely any right line whatever drawn through a point on the diagonal corresponding numerically to the principal focus of a lens cuts the sides at points representing its conjugate foci as it moves about this point as a center. In practice a rod may be pivoted at the given center. (*J. Phys.*, December, 1885, II, IV, 555.)

Rayleigh has described a monochromatic telescope which is a modification of Maxwell's color box. In this well-known instrument light passes through a slit in the focus of a collimating lens and traverses in succession this lens, a prism, and another lens, by which it is brought to a focus upon a plane surface in which is a movable slit, the eye placed behind this slit receiving light approximately monochromatic. If now, in addition, a lens be placed just behind the first slit so as to bring some distant object into focus at a convenient distance from the eye this object will be seen by the light that would enter the eye in the simple color box. The instrument is to be used to compare lights of different colors for practical purposes. (*Phil. Mag.*, June, 1885, V, XIX, 446.)

Malcolm has adjusted his binocular glass to eyes of different focal lengths by arranging one of the eye-pieces so that it can be moved through a small range in or out by turning a milled bead. An index arrangement is attached by which a given setting may always be reproduced. The unaltered tube is brought to the most perfect focus possible in the ordinary way, using only one eye. Then the other tube is used with the other eye and focused accurately with its own adjustment, the other remaining unchanged. (*Phil. Mag.*, June, 1885, V, XIX, 461.)

3. *Dispersion and Color.*

Wüllner, in 1883, showed that the index of any transparent substance could be very exactly represented in terms of wave length by a formula given by him. Since that time he has compared the experimental results obtained by Mascart and Esselbach with quartz in the ultra violet, and by Mouton and Langley for flint in the ultra red, and finds the formula very exactly verified in all cases. In the case of quartz the discrepancy reaches the third decimal place of the index only for the extreme red ($\lambda = 21{\cdot}4 \times 10^{-5}$.) In the case of flint the divergence becomes sensible only for the line O and for the extreme red ($\lambda = 28 \times 10^{-5}$). For the line O the value observed, 1·6266, lies between 1·6242 and 1·6277, calculated from Mascart's and Esselbach's wave lengths. (*Wied. Ann.*, XXIII, 306; *J. Phys.*, July, 1885, II, IV, 324.)

Clemenshaw exhibited to the London Physical Society some experiments in projecting the spectra of the metals without the aid of the electric light. A small quantity of a solution of the salt to be experimented on is put into a bottle in which hydrogen is being evolved by the action of dilute sulphuric acid on zinc. The bottle has three necks, through one of which an acid funnel is passed, a second carries the jet, and through the third hydrogen or coal gas is fed into the apparatus, the flame being thus regulated. The jet, which is from one-eighth to three-sixteenth inch in diameter, is surrounded by a larger tube, through which oxygen passes to the flame; the result being a brilliant light giving the spectrum of the substance, which is carried over mechanically by the evolved hydrogen. The spectra of sodium, lithium, and strontium were shown upon the screen and the absorption of the sodium light by a Bunsen flame containing sodium was clearly seen. (*Phil. Mag.*, May, 1885, V, XIX, 365; *Nature*, February, 1885, XXXI, 329.)

Koenig presented in May to the Physical Society of Berlin the plan of a new spectro-photometer then in course of construction. It consisted of a tube containing a lens and a diaphragm turned toward the source of light, and having two slits lying the one above the other, a prism for decomposing the two incident beams, and a second collimating tube with a disk closing the end, on which appeared the two spectra slightly separated. Before the lens of the observing telescope was placed a twin prism, the two halves, with refracting edges of 1° to 2°, being cemented together. By this twin prism each spectrum was decomposed into two spectra, and the dimensions of the twin prism were so determined that on the disk of the collimator one spectrum was situated above the other below, while in the middle the second spectrum from the upper slit coincided with the second spectrum of the lower slit. In the disk of the observing telescope a small opening is made cutting off a small piece of determinate wave length from the double spectrum, so that on looking through it the field of vision is seen divided by a line (the refracting edges of the twin prism) into two halves, both of the same coloring. Before each of the two slits of the slit collimator a Nicol prism was placed in such a position that light polarized in a vertical plane entered one and in a horizontal plane the other. The middle compound spectrum consisted therefore of a vertically and a horizontally polarized spectrum, and in the field of view the two like-colored halves were also polarized in perpendicular planes. If now the field is viewed through a Nicol prism, then according to the position of its principal section would the one half at one time and the other half at another time be invisible. So that if the two entering beams of light have different intensities their spectra may be equalized in brightness by rotating the Nicol; and from the degree of rotation the relative intensities be inferred. (*Nature*, June, 1885, XXXII, 191.)

Balmer, in calculating the wave lengths of the hydrogen lines as given by Angström, has found a relation between these lines expressed by the formula $h=\frac{m^2}{m^2-4}C$, when C has the value 3,645·6 millionths of a millimeter. In place of m let there be put in turn the numbers 3, 4, 5, 6; and the values for Angström's wave lengths of the four visible hydrogen lines are obtained. If for m, the values 7, 8, &c., up to 16 are used, values for hydrogen lines are obtained which correspond very well with the wave lengths of the lines which Dr. Huggins had found in the ultra-violet spectrum of the white stars and had recognized as the invisible hydrogen lines. This relation between the hydrogen lines had now received an increased significance from an investigation by Cornu, in which he had found a perfectly determinate proportionality between the lines of the ultra-violet spectrum of aluminum and of thallium, and the ultra-violet hydrogen lines. Like the hydrogen lines, the pairs of lines of the two metals referred to advanced much nearer to one another and became much paler the more one approached the more refrangible end of the spectrum; and if any line of the aluminum or the thallium spectrum was made to coincide with the corresponding line of the hydrogen spectrum then did all the remaining lines coincide. This relation obtained both for the first and for the second components of the pairs of lines in the metallic spectra. (*Nature*, July, 1885, XXXII, 312.)

Crookes has communicated to the Royal Society a paper on radiant matter spectroscopy, in which he gives the results of further researches on the prismatic analysis of the light emitted by the cerium group of earths when made to phosphoresce by the impact of radiant matter in high vacua. With regard to the double orange band observed in 1881, he details at length the extraordinary difficulties overcome in localizing it. "After six months' work I obtained the earth didymia in a state which most chemists would call absolutely pure, for it contained probably not more than 1 part of impurity in 500,000 parts of didymia. But this 1 part in 500,000 profoundly altered the character of didymia from a radiant matter spectroscopic point of view, and the presence of this very minute quantity of interfering impurity entailed another six months' extra labor to eliminate these traces and to ascertain the reaction of didymia pure and simple." Gradually the matter was narrowed down and the orange band was finally traced to samarium. Pure samarium sulphate alone gives a very feeble phosphorescent spectrum. But when the samaria is mixed with lime the spectrum is, if anything, more beautiful than that of yttrium. The bands are not so numerous, but the contrasts are sharper. Examined with a somewhat broad slit, the spectrum is seen to consist of three bright bands, red, orange, and green, nearly equidistant, the orange being the brightest. With a narrow slit the orange and green bands are seen to be double, and on closer examination faint wings are seen like shadows to the orange and green bands. But lime is not the only body which brings out the phosphorescent spectrum. The author divides the samaria spectra, as modified by other metals, into three groups. The first comprises the spectra given when glucinum, magnesium, zinc, cadmium, lanthanum, bismuth, or antimony is mixed with the samarium. It consists simply of three colored bands, red, orange, and green. The second type of spectrum gives a single red and orange band and a double green band, and is produced when barium, strontium, thorium, or lead is mixed with the samarium. The third type is given when calcium is mixed with the samarium. Here the red and green are single and the orange double. Aluminum would also fall into this class were it not that the broad, ill-defined, green band is also doubled. On mixing samaria and yttria no trace of the yttria spectrum was observable up to 57 per cent. of this earth. When it reached 65 per cent. a marked change took place. With 44 of samaria and 56 of yttria the pure samarium spectrum is given. With 42 samaria and 58 yttria some bands characteristic of each earth are seen; while 39 samaria and 61 yttria gives almost a pure yttrium spectrum, the sharp orange line, however, running across them all. Experiments made to test the delicacy of this method showed that when 1 part of samarium is mixed with 100,000 parts of calcium the green and red bands have almost disappeared, but the double orange band is still very prominent. With 1 to 500,000 and 1 to 1,000,000 the spectrum is the same though fainter. With 1 to 2,500,000 the bands of samarium have entirely gone and its presence is recognized only by the darkening in the yellow portion of what otherwise would be a continuous spectrum. (*Nature*, July, 1885, XXXII, 283.)

Barker has published an account of the experiments made by Henry Draper on the use of carbon disulphide in prisms for optical purposes. The extraordinary mobility of this liquid and its extreme sensitiveness to heat cause striæ in its mass, which interfere with and practically destroy its definition. Since Dr. Draper's experiments showed it to be the only substance by which the necessary dispersion could be readily obtained for photographing metallic spectra, he was exceedingly desirous of improving its definition. The desired object he found was readily obtained by simple agitation. A wire was passed through the stopper of the bottle (Thollon) prism, upon the lower end of which was a small propeller just dipping into the liquid. By means of a pulley on the upper end of the shaft, and a little electric motor, this propeller could be revolved rapidly so as to keep the liquid actively agitated. The effect was surprising. The sodium lines, with the propeller at rest, were fluffy and ill defined, united together and nebulous. But in a few seconds after starting it the lines became clear and remarkably sharp, continuing so as long as the motion continued. But now the effect of temperature became apparent in the shifting of the lines toward the red if the prism was rising and toward the blue if falling in temperature. For a change of about 9° the shifting was something over 3·5 inches. To overcome this shifting the prism was inclosed in an even-temperature box, and by means of a simple but ingenious thermostat the temperature was regulated so that in seven hours it varied by an amount sufficient to shift the sodium lines by only the distance between them. (*Am. J. Sci.*, April, 1885, III, XXIX, 269.)

Langley has investigated the optical properties of rock salt worked into prisms by Clark and by Brashear with such exquisite surfaces that they give a spectrum showing the Fraunhofer lines with all the sharpness of flint glass. Indeed, a rock-salt prism made by the latter shows the nickel line between the Ds. Experiments with a train of such prisms were made to determine not only the indices for different lines in the visible and invisible spectrum, but also the apparent transmission of rock-salt plates for different parts of the spectrum. Heat spectra were formed from radiating sources below the temperature of melting ice, and it was found that most of the rays, even from these sources, passed freely through the prism. With the smallest deviations, corresponding to wave lengths exceeding probably 100,000 of Ångström's scale, a slight absorption began to be noticed. A table is given of the refractive indices of a prism of angle 59° 57′ 54″ for the spectrum lines from M in the ultra violet to Ω in the ultra red; or from wave length 0·3727 to 1·32. The values in the visible spectrum are given to six places, those in the ultra red to four. For the line M, the refractive index is 1·57486; for G, 1·56133; for D, 1·54418; for A, 1·53670; and for Ω, 1·5268. In all, seventeen indices were measured. (*Am. J. Sci.*, December, 1885, III, XXX, 477.)

Lommel has suggested the use of phosphorescent substances, such as Balmain's luminous paint or a greenish-blue variety of phosphorescent calcium sulphide, for the purpose of rendering visible the focus of ultra-red rays in the well-known experiment of Tyndall on calorescence. If such a powder be made slightly phosphorescent by exposure to ordinary daylight the less refrangible rays increase it to a bright luminosity. In place of a solution of iodine in carbon disulphide as the absorbing solution, Lommel recommends a solution of nigrosin in alcohol or chloroform, preferably the latter. (*Wied. Ann.*, 1885, XXVI, 157; *Phil. Mag.*, December, 1885, V, XX, 547.)

Lommel has shown that if a conical beam of solar light be allowed to fall on a cube of Iceland spar, either directly or after passing a cobalt-blue glass, the cube emits a beautiful brick-red light. This light is not polarized and its composition does not depend upon the state of polarization of the incident beam. It is comprised between 35 and 65 of Bunsen's scale (between C and D $\frac{1}{2}$ E), its maximum being near 44. The exciting rays are almost exclusively visible rays, the most efficient being those between E and *b*. Hence Iceland spar presents a maximum of absorption at this point. (*Wied. Ann.*, XXI, 422; *J. Phys.*, November, 1885, II, IV, 535.)

Abney has described some lecture experiments on color mixtures, employing for this purpose a modification of Maxwell's color box. The spectrum, instead of being formed on a screen, is received upon a convex lens, which forms an image of the face of the prism on a screen. If all the light from the prism falls upon the lens this image is colorless. But by interposing a screen with a slit in the spectrum close to the lens, so as only to allow light of a given color to fall on the lens, the image appears colored with that light. By using two or more slits mixtures of different lights in any required proportion may be obtained. (*Nature*, July, 1885, XXXII, 263.)

4. *Interference and Polarization.*

Lummer has called attention to the fact that if a concave mirror, silvered over its whole surface excepting a small place the size of the pupil, be made to reflect the light of a lamp burning alcohol saturated with salt, normally upon a plate of plane glass with parallel faces, the eye placed at the opening when adjusted for distant objects will see the plate covered with a great number of concentric rings whose centers are at the foot of the normal from the center of the pupil on the plate. If a telescope adjusted for parallel rays be substituted for the naked eye, the incidence corresponding to each of these rings may be measured. This phenomena has been observed by Haidinger and studied by Mascart, who has given a formula giving the difference of path of the two interfering rays as a function of the incident angle. The author suggests this method to detect want of parallelism in glass, the rings being then irregular. (*Wied. Ann.*, XXIII, 49; *J. Phys.*, February, 1885, II, IV, 90.)

Moreland has described a mechanical model which he uses to illustrate the phenomena of interference. Two blocks cut in sine curves are attached to two points by strings fastened to their ends. At a point exactly perpendicular to the center of a line joining these two points the waves are in the same phase and reinforce each other. By moving both blocks either way a position is reached where they are in opposite phases and interfere. (*Am. J. Sci.*, January, 1885, III, XXIX, 5.)

Stokes has communicated to the Royal Society the results of an extended investigation of the brilliantly colored iridescent crystals of potassium chlorate sometimes obtained in the process of manufacture. He regards it as conclusively proved that the seat of the color is in a very thin twin stratum, and he entertains little or no doubt that the color depends in some way on the different orientation of the planes of polarization in the two components of a twin and on the difference of retardation of the two polarized pencils which traverse the thin stratum. Anything beyond this is at present only a matter of speculation Only two directions are indicated in which to look for a possible explanation; and these will form the subject of further investigation. (*Nature*, April, June, July, 1885, XXXI, 565; XXXII, 102, 224.)

From the researches of Tollens, Landolt, Schmitz, and others it is well known that cane sugar and many other substances have a specific rotatory power which varies continuously when the proportion of inactive liquid is increased. For sugar, however, the diminution is very feeble as the concentration increases, even more feeble than for glucose. With dilute solutions containing 1 to 5 per cent. of sugar, Hesse had found $[\alpha]_D = 68°$ about, a number rather higher than is obtained with more concentrated solutions. Tollens, operating upon dilute solutions with a polarimeter of great sensitiveness, has completely confirmed his earlier conclusions, and finds that whatever be the concentration the formula $[\alpha]_D = 66{\cdot}386 + 0{\cdot}015035p - 0{\cdot}0003986p^2$, where p is the weight of sugar in 100 of solution, always represents the variations of rotatory power. It has been confirmed on solutions containing from 1 to 67 per cent. of sugar. (*Ber. Berl. Chem. Ges.*, XVII, 1751.)

Madan has described a modification of Foucault's and of Ahrens's polarizing prisms. Ahrens's prism is made of three wedges of Iceland spar cemented together by Canada balsam. The optic axis in the two outer wedges is parallel to the refracting edge, while in the middle wedge it is perpendicular to the refracting edge and lies in a plane bisecting the refracting angle. By using three prisms the middle one may be given a very large angle, and yet the deviation of the rays may be so far corrected that on emergence they make equal angles with the central line. Nearly in contact with one of the terminal faces of the prism a prism of dense glass is placed of such an angle that it just corrects the deviation of one of the rays, and also achromatizes it, while it increases the deviation of the other ray to such an extent that it may be practically disregarded, an eye even when very close to the prism perceiving only the direct beam. (*Phil. Mag.*, January, 1885, V, XIX, 69.) Madan finds that the ordinary ray falls on the second surface of the middle prism of this combination at an angle greater than the critical angle and is therefore totally reflected if an air film be placed between this surface and the following one. Moreover, he finds that the deviation and the dispersion can be almost entirely corrected by making the third prism of crown glass combined with a prism of very dense flint glass of smaller angle. Its field is 28°. (*Nature*, February, 1885, XXXI, 371.)

ELECTRICITY.

1. *Magnetism.*

Werner Siemens has published a theory of magnetism and has detailed the experiments upon which it is based. In the first place, the Amperian theory must be extended by supposing that not only magnetic substances but all bodies, as well as empty space, are filled with circular currents of very small dimensions and that magnetic substances differ from non-magnetic substances only inasmuch as the number of circular currents present in the unit volume is much greater in the first case than in the second. All magnetic phenomena may then be referred to the property of the electric current of exerting a directive force upon the molecular solenoids which fill all space, but which are present in greater numbers in the so-called magnetic bodies, which place their axes at right angles to its direction and tend to bring them into closer concentric attraction circles. The magnitude of this rotation of the axes, depends, on the one hand, on the magnitude of the directive or magnetizing force, and, on the other hand, on the number of the molecular circuits pre-existing in the unit volume, for which condition the term "magnetic conductivity" may be employed, or that of "magnetic resistance" for its reciprocal value. Since a magnetizing force, acting upon the molecular magnets only, exerts a perceptible influence on the rotation apart from each other of the paired elementary magnets when all the neighbors in the magnetic circuit follow the motion and so are able to produce a closed system of equilibrium capable of mutual attraction, it follows that the rotation directly produced by the magnetizing force must be very small in comparison with the mutual strengthening of the rotation in the closed magnetic circuit. The magnetic moment produced must thus be essentially the product of the mutual strengthening of rotation of which the magnetizing force is the cause. (*Wied. Ann.*, XXIV, 93; *Phil. Mag.*, April, 1885, V, XIX, 237; *J. Phys.*, September, 1885, II, IV, 426.)

Bosanquet has published a series of magnetic measurements made to test his theory of magnetism. His formulas suppose that each molecule has one and only one axis of transmission (like a bead with a hole in it). The axis is capable of transmitting a certain number of lines of force and no more, and the molecular permeability is proportional to the defect of saturation. (If the hole in the bead be packed with thin wires the aperture remaining is represented by the number of wires that remain to be got in.) Regarding magnetism as a motion or displacement, whether dynamic or static, we may thus speak of the molecular permeability as a coefficient of freedom within the molecule. The reciprocal of the coefficient of the forces which tend to prevent the rotation of the molecule as a whole may be spoken of as a coefficient of freedom without the molecule. The product of these two coefficients by a constant is a characteristic of a given approximate state of a given piece of metal. As between the hard steel and the iron the product of the coefficients of freedom is proportional to the maximum permeability. In soft steel the molecular forces are chiefly extra-molecular, the freedom intra-molecular; in hard steel the reverse is true. In soft iron the average intra-molecular freedom is much greater than in hard steel, the extra-molecular freedom about the same. In soft steel the extra-molecular freedom is much diminished, the intra-molecular freedom is moderate or high. His figures show a maximum permeability for cast iron of 170 to 250, for malleable cast iron of 700 to 800, of wrought iron of 1,800 to 2,500, and of charcoal iron of 2,900 to 3,000. Hence the inference that ordinary cast iron is wholly unfit for use in dynamo machines. Malleable cast iron is an improvement, but is still very far inferior to wrought iron. (*Phil. Mag.*, January, February, May, October, 1885, V, XIX, 57, 73, 333, XX, 318.)

Lippmann has suggested a simple method by which the magnetic potential of a system of coils may be obtained without calculation. The three coils, α, β, and γ, are so placed at the summits of an equilateral triangle that their axes may form the three sides of an equilateral triangle, ABC. The variation of magnetic potential due to this system, and taken from B to C, is exactly equal to the product $4\pi ni$, i being the current strength and n the number of turns in each coil. In order to demonstrate this it is sufficient to remark that if the integral of the magnetic actions exerted by the coil α considered by itself be taken along the contour of the triangle ABC, this integral is exactly equal to $4\pi ni$, because the contour of the triangle is a closed line. On the other hand, the action exerted by α on the side CA may be replaced by the action of γ on the side BC, or the action of α on the side CA may be replaced by the action of β upon the side BC, so that finally the action of the system of the three coils on the side BC is equal to the sum of the actions exerted by α on the three sides of ABC, *i. e.*, to $4\pi ni$, as above. (*J. Phys.*, October, 1885, II, IV, 448.)

Ewing has communicated to the Royal Society the results of an extended investigation into magnetic susceptibility, and the influence upon it of various conditions, such as vibration, permanent strain, temperature, and the like; the experiments having been made in the laboratory of the University of Tokio. (*Nature*, January, 1885, XXXI, 304.)

Bakmetieff has studied the conditions of the production of heat by alternate magnetizations in a straight wire of iron, measuring the heat by means of a thermo-junction, so that the greater heating in the middle portions of the straight magnet and the equality of heating in all parts of the annular magnet could be readily observed. The proportionality of the heating to the square of the temporary magnetism was not confirmed; on the contrary, the author advances another law, *i. e.*, that the elevation of temperature of the iron by intermittent magnetization is proportional to the product of the magnetizing force and the magnetic moment. The greatest elevation of temperature observed corresponds to a magnetizing force more than sufficient to saturate the iron; hence the author concludes that it is the increase in the motion of the molecular magnets during magnetization which is most important in the production of heat. (*J. Soc. Phys. Chim. Russe*, XVI, 81, 257; *J. Phys.*, December, 1885, II, IV, 593.)

Fossati has shown that the common impression that the strength of a horse-shoe steel magnet is increased by hanging it up and gradually increasing the weights hung on its keeper is entirely an error, the increase in portative force being the same whether the magnet be weighted or not. This increase is in all cases much less than is supposed; and its variation is accompanied by a corresponding variation in distribution. (*Il Nuovo Cimento.*, XV, 158, 232; *J. Phys.*, December, 1885, II, IV, 565.)

Barus and Strouhal have published, as the fourteenth Bulletin of the U. S. Geological Survey, an extended memoir on the physical characteristics of the iron carburets; more particularly on the galvanic, thermo-electric, and magnetic properties of wrought iron, steel, and cast iron in different states of hardness, together with a physical diagram for the classification of iron carburets. With reference to steel, the authors say: "The difference between the logarithms of the respective values of thermo-electric hardness for the same carburation passes through a pronounced maximum defining a carbide, the mechanical properties of which are those of a type steel and may be fully given thus: Let each member of the whole series of iron carburets be subjected successively to the following operations: I, A process of very slow cooling from a given temperature in red heat; II, a process of most rapid cooling possible from the same temperature. If now the carburets be examined with reference to the hardness produced in the two istances there will be found among them a certain unique member whose properties are such that while process I has more nearly identified it with pure soft iron, process II will have moved it farther away from this initial carburet than is simultaneuosly the case with any other iron-carbon product; a unique member, in other words, which is capable of occurring in the greatest number of states of hardness relative to the soft state possible. To the said product the term 'steel' is to be applied."

Perkins has made an investigation on the variation of the magnetic permeability of nickel at different temperatures and has plotted the results obtained. The curves show that at the first all the magnetism is temporary. The permeability rises to a maximum at about the same place as that of total magnetization, then falls less rapidly and approaches the total, though it is evident that it can never reach it, since the permanent magnetism cannot be less for a high magnetizing force than for a lower at any given temperature. (*Am. J. Sci.*, September, 1885, III, XXX, 218.)

Hurion has examined and confirmed the statement of Righi that the electric resistance of bismuth increases when this metal is subjected to the action of an electro-magnet. From his experiments he concludes that the variation in the resistance of bismuth under these circumstances arises in great part from the mechanical action exerted by the magnetic field on the metal. However, it seems that the variation of the resistance is a little more rapid than this mechanical action. (*J. Phys.*, April, 1885, II, IV, 171.)

Töpler has suggested the use of the balance in measuring the quantity MH in determining the horizontal component of the earth's magnetism. For this purpose a magnetized bar is fixed perpendicularly to the brass beam of a balance in place of the ordinary pointer. Weights are placed in the scale pans in order to make the axis of the magnet vertical when the plane of oscillation is in the magnetic meridian. The balance is then turned through 180° and again the axis is adjusted to verticality by shifting the weights. MH is then equal to $\frac{1}{2}(Q_1-Q_2)\,l$; in which l is the length of that arm of the beam to which the weights Q_1 and Q_2 have been added. The author details the precautions necessary to insure accuracy, and claims $\frac{1}{4000}$ as the limit of precision of the method. (*Wied. Ann.*, XXI, 158; *J. Phys.*, December, 1885, II, IV, 587.)

Gray has described the methods in use in the laboratory of the University, Glasgow, for determining the value of the earth's horizontal component. Experiments to determine the effect of length and hardness on the induction coefficient of the deflector magnets show that the length of the magnets should be at least forty times their diameter and that they should be made as hard as possible. The results are given in a table. (*Phil. Mag.*, December, 1885, V, XX, 484.)

2. *Electric Generators.*

The paper on the seat of the electro-motive forces in the voltaic cell with which Lodge opened the discussion of this subject at the Montreal meeting of the British Association has appeared in full, and is a most valuable and impartial résumé of the history of this important subject, and an able argument in favor of the views that the apparent difference of potential of copper and zinc is in fact the sum of a copper-air and a zinc-air contact difference. (*Proc. British Assoc.* for 1884, 464; *Proc. Soc. Teleg. Eng. and Elec.*, XIV, 186; *Phil. Mag.*, March, April, May, June, October, 1885, V, XIX, 153, 254, 340, 487; XX, 372.)

Koosen has constructed a form of battery based on the depolarizing action of bromine. It consists of a glass jar having a narrow prolongation at its lower portion to contain the bromine, above which is a porous plate supporting a porous cup containing a rod of amalgamated zinc. A platinum wire traversing the porous plate makes communication with the bromine. The upper portion of the jar is filled with dilute sulphuric acid, on which rests a thin layer of petroleum to prevent the escape of the bromine vapors into the atmosphere. The electro-motive force of the combination is 1·9 volts and becomes somewhat higher if the platinum is replaced by carbon. The internal resistance is considerable, but the battery is very constant. (*Wied. Ann.*, XXIII, 348; *J. Phys.*, August, 1885, II, IV, 373.)

Von Helmholtz has constructed a modified form of Daniell cell, which consists of a deep glass goblet, in the bottom of which is a copper spiral connected with a platinum wire insulated in a glass tube and reaching to the surface. The spiral is covered with copper sulphate solution, which can be replaced by fresh solution poured in through a funnel reaching to the bottom. On this solution lies a solution of zinc sulphate in which the zinc cylinder is placed. A siphon whose outer leg is directed from below upwards dips into the liquids as far as the bounding plane, so that on pouring in fresh copper solution only the colorless supernatant zinc solution flows off. The upper solution is by this means kept free of copper, although after awhile some copper was found to be precipitated upon the zinc cylinder, not sufficient, however, to impair the constancy of the cell. (*Nature*, January, 1885, xix, 308; *Am. J. Sci.*, March, 1885, III, xxix, 257.)

Hayes and Trowbridge have investigated by a photographic method the irregularities which occur in the action of galvanic batteries, and have sought to ascertain the cause thereof. Since batteries in which there is no porous partition do not show irregularities, while those containing porous cups all give more or less marked variations, the authors believe that these irregularities are due, first, to a clogging of the pores of the partition by some product of the action, and, second, to electrical osmose; the undulations being due to the former cause, and the fluctuations, which are superposed upon the undulations, to the latter. A cup of very dense earthenware gives both undulations and fluctuations, while one which was very porous gave fluctuations without undulations. Since, as Wiedemann has shown, a porous cup increases the amount of metal transported to the negative pole and diminishes the quantity of acid at the positive pole, a battery containing a small, thick cup and giving a strong current will possess a maximum force tending to drive the liquid and base from the positive pole and to cause a corresponding decrease in the current strength. Hence the partition should be made of as large surface dimensions as possible, and should be made of very porous material. (*Am. J. Sci.*, July, 1885, III, xxx, 34.)

It follows, as a consequence of the law of the conservation of energy, as has been shown by Von Helmholtz and Thomson, that the electro-motive force of non-polarizing batteries is proportional to the energy of the reactions developed in them by the passage of the current and may be calculated from these reactions. To make this proposition incontestable it is necessary that the total chemical energy of the battery should be converted necessarily into electric energy. The theoretical discussion of this question has been recently made by Von Helmholtz, and Czapski has undertaken to investigate experimentally the following results drawn from Von Helmholtz's conclusions: The batteries which do not transform all the chemical energy into electrical energy are those the electro-motive force of which decreases as the temperature rises, and those which produce an electrical energy in excess of their calorific energy are those in which the electro-motive force increases with the temperature. Czapski's results confirm in general this theory of Von

Helmholtz. (*Wied. Ann.*, XXI, 209; *J. Phys.*, December 1885, II, IV, 578.)

Bidwell has constructed a voltaic cell having a solid electrolyte. He exhibited to the London Physical Society a cell consisting of plates of silver and copper, between which was contained a mixture of one part of copper sulphide and five of sulphur. The electro-motive force was 0·07 volt and the internal resistance 6,537 ohms, and the current readily deflected the needle of a reflecting galvanometer so as to throw the light off the scale. A second cell was made with a copper plate on which copper sulphide had been pressed and a silver plate resting on silver sulphide on the surface of the copper sulphide. The silver plate was brushed over with a dilute solution of sulphur in carbon disulphide and then heated till the free sulphur was driven off. On putting the cell together it produced a current of 6,800 micro-amperes through an external resistance of 0·2 ohm. The copper and silver plates were each 2½ by 2 inches, and the thickness of the two layers of sulphide 0.05 inch. The electro-motive force of the cell is 0·053 volt, and its internal resistance is therefore about 7 ohms. (*Nature*, August, 1885, XXXII, 345; *Phil. Mag.*, October, 1885, V, XX, 328.)

The interesting subject of the behavior of selenium to light as regards its electric resistance has been examined by several investigators. Werner Siemens has described the electro-motive action of certain selenium cells sent to him by Fritts, who first observed in them the fact that, when placed in circuit with a galvanometer, an electric current flowing from the gold leaf to the base plate was generated by the action of light. Siemens confirms this observation and regards it as of the greatest scientific importance. Since obscure thermal rays are without effect, the action cannot be a thermo-electric one. Moreover, the electro-motive force developed is proportional to the intensity of the light. He concludes, therefore, that "here we meet for the first time with an instance of the direct conversion of the energy of light into electrical energy." (*Ber. Ak. Berl.*, February, 1885; *Phil. Mag.*, April, 1885, V, XIX, 315; *Am. J. Sci.*, June, 1885, III, XXIX, 495.)

Bidwell has investigated very carefully the phenomena of selenium cells and is disposed to regard the change of resistance by the action of light as a phenomenon of electrolysis. Since the selenium in the cells has always undergone a prolonged heating in contact with the metallic terminals, selenides of these metals may exist within the selenium, forming a kind of network, thus affording the conducting material throughout the mass. A cell constructed of silver wires and sulphur containing some silver sulphide was sensitive, its resistance being reduced to one-third by burning a piece of magnesium wire near it. In the electrolysis of silver sulphide, however, sulphur itself would be deposited on the metallic plate, and the resistance would be enormously increased, unless under the action of light this sulphur united with the silver. Moreover, he finds the specific resistance of selenium to be 2,500 megohms, a value very much higher than that in the cells, thus suggesting the formation of selenides which act as conducting bodies. (*Phil. Mag.*, August, 1885, V, xx, 178; *Nature*, June, July, 1885, xxxii, 167, 215; *Am. J. Sci.*, October, 1885, III, xxx, 313.)

The Clamond thermo-battery has been improved in the details of its construction and its efficiency increased. A model made up of one hundred and twenty pairs gave an electro-motive force of 8 volts and had an internal resistance of only 3·2 ohms. Another battery, containing sixty pairs, gave an electro-motive force of 3·6 volts and an internal resistance of only 0·65 ohm. Both batteries consumed about the same amount of gas, about 180 liters per hour. (*Am. J. Sci.*, June, 1885, III, xxix, 495.)

Kayser has given to the Berlin Physical Society an account of the measurements he has made on an improved form of Noe thermo-electric generator, differing from the old one in the fact that the bars of the bismuth alloy are now connected by strips of an alloy offering greater resistance to heat than did the wires formerly used. The resistance at the ordinary temperature was 0·9 Siemens unit and rose as the gas consumption increased to about 1·2 s. u. when this consumption was $60^{c.c.}$ per hour. The curve of electro-motive force formed a straight line. As to the cost of generating electricity in this way, a current of one ampere for an hour cost about one pfennig, whereas with the Bunsen cell the cost is about three times as great. (*Nature*, January, 1885, xxxi, 308.)

Von Waltenhofen has observed that if an electric current from any source whatever be passed through an ordinary thermo-electric element, and then the element be put on a closed circuit, a current will be obtained contrary in direction to the exciting current. This inverse current results of course from the difference of temperature produced by the current at the junctions in virtue of the Peltier effect. If, however, the ordinary thermo-electric element be replaced by a dissymetric thermopile, like the Noe battery, it will be observed that, according to the direction of the current sent into it, the intensity of the secondary current will vary, but its direction will remain the same. It is therefore independent of the direction of the charging current. (*Wied. Ann.*, xxi, 360; *J. Phys.*, December, 1885, II, iv, 572.)

3. *Electrical Units and Measurements.*

Jamieson has presented a paper to the Society of Telegraph Engineers and Electricians upon electrical definitions, nomenclature, and notation, calling attention to the very considerable confusion of the electrical vocabulary in consequence of the rapid progress of electrical science, a variety of terms being used to express the same idea on the one hand and on the other the same term being used in many different senses. He suggests how these names should be restricted, and gives a set of symbols for them by which they should always be represented in formulas. The society was asked to appoint a committee to take this subject into consideration and to act with a similar committee already appointed by the Société Internationale des Electriciens. (*Proc. Soc. Teleg. Eng. and Elec.*, XIV, 297; *Nature*, June, 1885, XXXII, 184.)

The British Association committee on electrical standards reported at the Aberdeen meeting, through the secretary, that they had had constructed a series of coils to serve as standards in terms of the legal (Paris) ohm, assuming this ohm to be 1·0112 B. A. unit. These standards, ten in number, had been carefully compared with each other, by the methods already described in reports of the committee, and also with mercury tube resistances prepared by Benoit, of Paris. The legal ohm standards as constructed by the committee exceed those constructed in Paris by 0·00049 legal ohm. Standards of electro-motive force and of capacity should also be issued by the committee, in their opinion. (*Nature*, October, 1885, XXXII, 528.)

Klemencic has determined the ratio between the electro-static and the electro-magnetic systems of units by the following method: The current of a battery of 9 to 15 Daniell cells is made to charge a condenser which is then discharged through the wire of a galvanometer. The permanent deviation which results from these continuous discharges is noted, as well as the arc of impulsion of the galvanometer under the influence of the direct current from the battery. The capacity of the condenser is then calculated in electro-magnetic measure. The value in electro-static measure is deduced from the theory of Kirchhoff. In other experiments the battery charges the condenser, and at the same time acts upon a differential galvanometer through one of its coils placed in shunt circuit. The discharge of the condenser traverses the second wire and the resistances are so regulated that there is no deviation. The author gives as the value of the constant v of Maxwell, $3·0188 \times 10^{10}$ cm. sec. (*Ber. Ak. Wien.*, 1884, 88; *J. Phys.*, April, 1885, II, IV, 183.)

Fletcher has determined the value of the B. A. unit of resistance in terms of the mechanical equivalent of heat, and has obtained the value 0·9904 earth quadrants per second. The method consisted in simultaneous thermal and electrical observations of the energy expended by an electrical current in a coil of wire immersed in a calorimeter. (*Am. J. Sci.*, July, 1885, III, XXX, 22.)

Himstedt has published the results of his determination of the ohm made by a method suggested by him in 1884. The constant deviations of a magnetic needle in the same galvanometer, produced in the one case by means of induction currents passing in the same direction through the galvanometer at the rate of n per second, and in the other by means of a constant current whose strength is a known fraction of the inducing current, are carefully observed, and from the data thus obtained the resistance can be calculated. The lowest value obtained for the resistance of the Siemens unit was 0·94323 and the highest 0·94380 ohm, the mean being 0·94356 ohm. Hence 1 ohm is equivalent to the resistance of a mercury column having a section of 1 square millimeter and a length of 105·98 centimeters at 0° centigrade. (*Phil. Mag.*, November, 1885, V, xx, 417.)

Wild gives from his measurements the number 0·94315 ohm for the value of 1 Siemens unit, and therefore gives 106·027 centimeters as the length of the mercury column representing the ohm at 0°. (*Am. J. Sci.*, February, 1885, III, xxix, 168.)

Because of the importance of having as little heating as possible in all instruments for electric measurement, the question has arisen whether the coils of such instruments should be made of German-silver wire or of copper wire or partly of both, and how the diameters of the wire should vary in different parts of the coil. Ayrton and Perry have investigated the conditions that make this heating error a minimum with cylindrical coils of given internal and external radii, and have reached the conclusion that the wire should be of copper and that the increase of cross-section proceeding from the center should be $x=x_0 r^{0\cdot4}$. Other points in connection with these instruments were discussed. (*Nature*, July, 1885, xxxii, 215.)

Fleming has constructed a standard Daniell cell, consisting of a U tube, in the two limbs of which are the two solutions of copper sulphate and zinc sulphate of the same specific gravity. Electrodes made of freshly electro-deposited copper and pure zinc that has been twice distilled dip into the two limbs. The electro-motive force of this cell is 1.102 volts, and the variation with temperature is practically nil. The various conditions affecting the electro-motive force of this cell were carefully studied. (*Phil. Mag.*, August, 1885, V, xx, 126; *Nature*, July, 1885, xxxii, 263.)

Hesehus has designed an amperemeter founded on the phenomenon of Peltier. A thermo-electric battery of 12 iron-German silver elements, in the form of wires $2\cdot3^{mm}$ in diameter. is so arranged that the opposite junctions are contained in two vessels which form the reservoirs of a differential air thermometer. A current passed through the battery heats the even junctions and cools the uneven ones, or *vice versa*; and this causes a change of level in the thermometer proportional to the intensity of the current, eliminating the heating of the conductors. One division on the scale of his apparatus corresponds to 0·66 ampere. (*J. Soc. Phys. Chim. Russe*, xvi, 452; *J. Phys.*, December, 1885, II, iv, 587.)

Rosenthal has devised a galvanometer of great range and great sensitiveness, the needle of which is a horseshoe magnet suspended by a long fiber attached to its neutral point. The poles of the magnet are provided with horizontal pole pieces which are quadrantal arcs of a circle the center of which lies in the axis of suspension of the horseshoe. These pole pieces can play within the axis of two galvanometer bobbins placed on opposite sides of the vertical suspension plane when this plane coincides with the magnetic meridian. When an electric current passes through the coils these pole pieces are respectively drawn in or repelled by the two bobbins. In this way the poles of the magnet can be brought very near the center of the coils. Without the exterior magnet, $0 \cdot 1^{\mathrm{mm}}$ deflection at a scale distance of 2·7 meters corresponds to 54×10^{-10} ampere; with this magnet, to 12×10^{-10} ampere. With a German-silver and iron couple a difference of 10° between the junctions gave a deflection of 120^{mm} through 1,000 ohms. (*Wied. Ann.*, XXIII, 677; *Am. J. Sci.*, February, 1885, III, XXIX, 167.)

Anthony has devised a large tangent galvanometer for the laboratory of Cornell University as a standard instrument for the measurement of heavy currents and for the direct calibration of commercial measuring apparatus. It has four circles, two of which are 2 meters in diameter and two are 1·6 meters, mounted on the plan of Von Helmholtz at distances apart equal to their radii, and made of rods of copper 0·75 inch in diameter. The needle is suspended by a silk fiber and is inclosed in a mass of copper, which serves as an effectual damper and enables readings to be made very rapidly. A special arrangement of mirrors and telescopes permits the reading of the deflections in angular measure on a circle 50 inches in diameter to within 0·3 of a minute of arc. The copper conductors are mounted on a brass framework accurately turned and adjusted and the dimensions are all known within one five-thousandth part. For the measurement of currents there are two circles, each 1·5 meters in diameter and each having two conductors, together comprising seventy-two turns of No. 12 copper wire. (*Electrician and Electrical Engineer*, October, 1885, IV, 372; *Nature*, October, 1885, XXXII, 634.)

Mather has suggested the calibration of a galvanometer by a constant current as follows: A current is passed through its coils, and the instrument is turned through any angle and the deflection θ noted. The current is broken, and the needle swings back into the meridian, passing through an angle δ. This operation is repeated with the same current, the galvanometer being in various positions; and a curve is drawn showing the relation between $\sin \theta \div \sin \delta$ and the corresponding values of θ. When now the instrument is used in its normal position it is obvious that a current producing a deflection θ of the needle is proportional to the value of $\sin \theta \div \sin \delta$ corresponding to θ obtained in the calibration experiment; and this value can be read off directly from the curve. (*Nature*, December, 1885, XXXIII, 166.)

Trowbridge, while in general preferring the electro-dynamometer in the form devised by him to his cosine galvanometer (described in 1871) for the measurement of strong currents, yet has suggested a method of using the latter instrument which removes most of the objections. The galvanometer is so mounted that its compass is at the center of a large circle of wire the plane of which is vertical and in the plane of the needle. When the strong current is passed through the large vertical coil the arrangement acts as a tangent galvanometer. The movable coil of the cosine galvanometer is then connected with a Daniell cell of known electro-motive force, and in the same circuit a resistance is placed so large that the battery resistance may be neglected, and, having joined the poles in such manner that the deflection produced by the coil of the cosine galvanometer shall be opposite to that produced by the current in the large outer coil, the coil of the cosine galvanometer is inclined until the compass needle is brought again to zero. In this way the strength of the dynamo current is obtained in terms simply of the current from the standard Daniell cell, and the method is independent of the strength of the earth's magnetism and of the special field in which the instrument is placed. (*Am. J. Sci.*, March, 1885, III, xxix, 236; *Phil. Mag.*, May, 1885, V, xix, 396.)

Cailletet and Bouty have determined the conductivity of the metals at very low temperatures, in baths of methyl chloride, either alone or mixed with carbon dioxide snow, and of liquid ethylene, the temperatures being determined by means of the hydrogen thermometer. They conclude: (1) That from 0° to $-100°$ the formula $r_t = r_o (1 + \alpha t)$, in which r_o and r_t represent the resistance at 0° and $+ t°$, t the temperature, and α the increase-coefficient, represents the variation of resistance for the pure metals with sufficient exactness; (2) that if α be determined by the use of a metallic spiral, the temperatures from 0° to $-100°$ may be measured by the variation of resistance of this spiral with an error of less than 1°; (3) that for each metal α has a special value, which is in general somewhat above that of the expansion-coefficient of a gas. Hence the application of the formula above given leads to a zero value for the resistance at a temperature somewhat above $-273°$. It follows, therefore, that at exceedingly low temperatures the variation of resistance becomes less rapid. The temperatures calculated from the above formula consequently are, for these low temperatures, too near zero. (*J. Phys.*, July, 1885, II, iv, 297.)

Bartoli has examined twenty-three varieties of carbon with reference to their electric resistance. He concludes that to be a conductor the carbon should not contain more than 1·2 per cent. of hydrogen, and should have been submitted to a temperature not below a red heat. He finds that an intimate mixture of twenty parts of paraffin and one of graphite, by fusion, however, conducts so well that plates of it may be employed as electrodes; and yet elementary analysis would show 14·3 per cent. of hydrogen. He believes, therefore, that the conductivity of carbons is due exclusively to the presence in them of finely divided graphite intimately mixed throughout their mass. (*Il Nuovo Cimento*, xv, 203; *J. Phys.*, December, 1885, II, iv, 563.)

4. *Electric Spark and Electric Light.*

Edlund has contributed further experimental evidence of the position maintained by him, that an absolute vacuum is a good conductor and that the increase of resistance experienced in the ordinary tubes as the exhaustion proceeds is due to the development of a progressively increasing counter electro-motive force at the electrodes, a point which he has now rendered probable. A glass tube, 30^{cm} long and 16^{mm} in diameter, provided with two platinum wire electrodes, the ends being 3^{mm} apart, and with two bands of tin foil, was connected to the mercury pump while the terminals of an induction coil were connected alternately with the electrodes and with the tin-foil bands. When the pressure in the tube was above 36^{mm} no discharge could be observed between the tin-foil coatings, though that between the platinum wires became very brilliant. At about 1^{mm} a luminosity between the armatures was observable, which increased to $0·004^{mm}$ when it was intense, the spark between the electrodes being feeble. At $0·00036^{mm}$ the electrode spark appeared only occasionally, while the armature discharge was constant and very bright. The two discharges give exactly opposite results, that between the electrodes diminishing with the exhaustion and that between the armatures increasing with it. The author can explain this and other similar experiments only by the supposition that the resistance of the vacuum itself diminishes as the rarefaction increases and that there is developed simultaneously at the electrode a condition which hinders the passage of the electricity into the air from the metal. (*Phil. Mag.*, February, 1885, V, XIX, 125; *J. Phys.*, June, 1885, II, IV, 273.)

Goldstein has made the following remarkable experiment on the propagation of electricity through a vacuum. A Geissler tube has for its negative electrode either a platinum loop or a carbon filament from a Swan lamp. By means of a battery these loops are raised to incandescence, and then the discharge of an induction coil is sent into the tube. A shunt circuit connected with the two spherical terminals of a spark interrupter permits the graduation of the length of spark sent through the tube. Measured in this way the resistance of the Geissler tube is at least one hundred times less when the electrodes are heated to incandescence than when the cathodes are cold. The incandescence of the positive electrode is without influence. (*Ber. Ak. Wien*, 1884, 58; *J. Phys.*, April, 1885, II, IV, 182.)

This result appears entirely analogous with certain phenomena observed by Edison in the spring of 1884 in his incandescent lamps. Inserting a platinum electrode in the lamp, between the sides of the carbon loop, he noticed that when the lamp was brought up to incandescence a galvanometer connected on the one side to this platinum plate and on the other to the positive conductor, showed a deflection increasing with the degree of incandescence. The carbon filament was, in this case, an incandescent electrode as above, and the electro-motive force of the machine, about 110 volts, was under these conditions sufficient to cause a discharge through the vacuum. (*Science*, October, 1884, IV, 374; *Nature*, April, 1885, XXXI, 545.)

Lehmann concludes that the apparent difference of properties of positive and negative electrification in vacuum tubes is due entirely to secondary actions dependent upon the state of charge which the air takes in consequence of its friction against the electrodes. This electrification thus produced is always positive, and therefore the discharge is favored at the cathode and rendered more difficult at the anode. Indeed, the latter is, in a certain sense, prolonged by the layer of gas, positively electrified, which surrounds it, and which produces the dark space around this electrode. In this space the discharge is convective and continuous, becoming luminous and discontinuous only beyond it at a variable distance depending upon the pressure of the gas and upon its temperature. (*Wied. Ann.*, XXII, 305; *J. Phys.*, December, 1885, II, IV, 570.)

Naccari and Guglielmo have continued their investigations on the heating of the electrodes produced by the induction spark in rarefied air. They had previously shown that for pressures of air above 10^{mm} the negative electrode heated more than the positive in the ratio of 1 to between 2 and 4. For lower pressures they now show that this ratio increases slowly up to a pressure of 5^{mm}, more rapidly from 5 to $1{\cdot}2^{mm}$, and very rapidly up to a pressure of $0{\cdot}27^{mm}$, when it reaches a maximum value of 28. It then decreases, and for the lowest pressures obtainable is reversed and becomes less than 1. (*J. Phys.*, December, 1885, II, IV, 561.)

Ayrton and Perry have communicated to the Physical Society of London a paper on the most economical potential difference to employ with Edison incandescent lamps. They point out the fact that it is not sufficient to know that when a lamp is giving out a certain number of candles it absorbs so much power per candle, and when giving out a much larger number of candles it absorbs so much less power per candle. What must be known in addition is the life of the lamp at each of these two candle-powers before we can decide upon the most economical temperature for it; since if the efficiency is low at low temperatures, the life is great, and at high temperatures the larger efficiency will be balanced somewhat by its short life. From a curve given by calculation, and assuming the cost of the lamp 5*s.*, the number of hours of burning per year 560, and the cost of one electric horse-power for this time as £5, the authors show that the minimum cost per candle per year is 11*d.*, and is obtained with a potential value of 101·4 volts, the cost rising to 1*s.* per year if the potential falls to 98·7 or rises to 104 volts. (*Phil. Mag.*, April, 1885, V, XIX, 304; *Nature*, March, 1885, XXXI, 450.)

Fleming has made extended investigations into the phenomena of incandescent lamps with special reference to their efficiency. From statistics concerning the life, resistance, efficiency, and potential difference of such lamps he has constructed empirical equations showing the mutual relations of these variables. A curve showing the relation of any one of these to any other is called a characteristic curve for that lamp. His results confirmed the law formulated by Ayrton and Perry, that for a certain class of lamps (*i. e.* the Edison) the potential difference, minus a constant, varies as the cube root of the efficiency, the latter quantity being measured in candles per horse-power. The constant which in the lamps examined is about 28·7, is nearly the potential difference at which the lamps begin to emit light. Hence the law may be stated as follows: The effective potential difference varies as the cube root of the efficiency. (*Phil. Mag.*, May, 1885, V, XIX, 368; *Nature*, April, 1885, XXXI, 522.)

Fleming has further studied the phenomenon of molecular shadows in Edison incandescent lamps. In his earlier experiments he suggested the similarity of the phenomenon in question to those observed in high vacua by Crookes, the surface of the glass being coated with a deposit of carbon, with the exception of a clear line marking the intersection of the glass with the plane of the loop, and being in fact a shadow of the loop, apparently caused by the emission of matter from the terminals. The author has now succeeded in producing this phenomenon at will by passing a very strong current momentarily through a lamp, and has produced similar deposits of various metals used as electrodes. These deposits show colors by transmitted light, and, as a general result, he concludes that red metals, such a gold and copper, appear green by transmitted light, whereas white metals, like silver and platinum, appear brown. This result is obviously of the same character as that obtained by Wright.—*Am. J. Sci.*, 1877, III, XIII, 49; XIV, 169. (*Phil. Mag.*, August, 1885, V, XX, 141; *Nature*, July, 1885, XXXII, 263; *Am. J. Sci.*, October, 1885, III, XXX, 314.)

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NECROLOGY OF PHYSICISTS, 1885.

Silliman, Benjamin, Professor of Chemistry in Yale College. Author of a text-book on Physics. Died at New Haven, Conn., January 13, 1885, aged 68 years.

Rosetti, Francisco, Professor of Physics in the University of Padua. Well known for his researches on electro-statics and the temperature of the electric arc. Died in Padua, April 20, 1885, at the age of 52 years.

Jenkin, Fleeming, Professor of Engineering in the University of Edinburgh. Distinguished as an electrician, especially in connection with the Atlantic cable. His last work was the system of electrical transport called telepherage. Died in Edinburgh, June 12, 1885, at the age of 52.

TRESCA, HENRI, Professor of Industrial Mechanics and afterward Director of the Conservatoire des Arts et Métiers, Paris. Elected a member of the French Academy in 1872. Eminent for his researches on the Flow of Metals and other mechanical subjects. Died in Paris, June 21, 1885, aged 71 years.

EKLUND. A. W., Professor of Physics at the University of Lund, Sweden. Died at Lund, July, 1885, at the age of 90 years.

MANGIN, Colonel, of the French army. Inventor of the electric light projector known by his name. Died in Paris, of apoplexy, in November, 1885, aged 45 years.

CARPENTER, WILLIAM B., the eminent physiologist. Noted in physics for his work on the microscope. Died in London, November 10, 1885, aged 73 years.

ANDREWS, THOMAS, Professor of Chemistry in Queen's College, Belfast, until 1879. Well known for his researches on the Continuity of the Gaseous and Liquid states. Died in Belfast, November 26, 1885, aged 72 years.

CHEMISTRY.

By H. Carrington Bolton, Ph. D.,

Professor of Chemistry, Trinity College, Hartford.

GENERAL AND PHYSICAL.

Present Aspects of the Theory of Chemical Action.—In his presidential address to the chemical section of the British Association for the Advancement of Science, at the Aberdeen meeting, Prof. Henry E. Armstrong considered, among other things, the present aspects of the theory of chemical action. He said: Chemical action may be defined as being any action of which the consequence is an alteration in molecular constitution or composition; the action may concern molecules which are of only one kind—cases of mere decomposition, of isomeric change, and of polymerization; or it may take place between dissimilar molecules—cases of combination and of interchange. Hitherto it appears to have been commonly assumed and almost universally taught *by chemists* that action takes place directly between A and B, producing AB, or between AB and CD, producing AC and BD, for example. This, at all events, is the impression which the average student gains. Our text books do not, in fact, as a rule deign to notice observations of such fundamental importance as those of De La Rive on the behavior of nearly pure zinc with dilute sulphuric acid, or the later ones of Faraday (*Exp. Researches*, Series VII, 1834, 863 *et seq.*) on the insolubility of amalgamated zinc in this acid. Belief in the equation $Zn+H_2SO_4=H_2+ZnSO_4$, hence, becomes a part of the chemist's creed, and it is generally interpreted to mean that zinc *will* dissolve in sulphuric acid forming zinc sulphate, not, as should be the case, that *when* zinc dissolves in sulphuric acid it produces zinc sulphate, &c.

In studying the chemistry of carbon compounds we become acquainted with a large number of instances in which a more or less minute quantity of a substance is capable of inducing change in the body or bodies with which it is associated without apparently itself being altered. The polymerization of a number of cyanogen compounds and of aldehydes, the "condensation" of ketonic compounds and the hydrolysis of carbohydrates are cases in point, but so little has been done to ascertain the nature of the influence of the contact-substance, or *catalyst*, as I would term it, the main object in view being the study of the product of the reaction, that the importance of the catalyst is not duly appreciated. Recent discoveries, however—more particularly Mr. H. B. Dixon's invaluable investigation on conditions of chemical change in gases, and the experiments of Mr. Cowper with chlorine and various metals, and of Mr. Baker on the combustion of carbon and phosphorus—must have given a rude shock, from which it can never recover, to the belief in the assumed simplicity of chemical change. The inference which I think may be fairly drawn from Mr. Baker's observations—that *pure* carbon and phosphorus are incombustible in *pure* oxygen—is indeed startling, and his experiments must do much to favor that "more minute study of the simpler chemical phenomena" so pertinently advocated by Lord Rayleigh. (See Presidential Address to the B. A. A. S., at the meeting of 1884.)

But if it be a logical conclusion from the cases now known to us, that chemical action is not possible between any two substances other than elementary atoms, and that the presence of a third is necessary, what is the function of the third body, the catalyst, and what must be its character with reference to one or both of the two primary agents? In the discussion which took place at the chemical society after the reading of Mr. Baker's paper, I ventured to define chemical action as *reversed electrolysis*, stating that in any case in which chemical action was to take place, it was essential that the system operated upon should contain a material of the nature of an electrolyte (*Chem. Soc. Proc.*, 1885, p. 40). In short, I believe that the conditions which obtain in any voltaic element are those which must be fulfilled in every case of chemical action. There is nothing new in this; in fact it was stated by Faraday in 1848 (*Exp. Researches*, series VII, § 858 and § 859); and had due heed been given to Faraday's teaching, we should scarcely now be so ignorant of the conditions of chemical change. (*Chem. News*, LII, 135.)

Suggestions as to the Cause of the Periodic Law and the Nature of the Chemical Elements. (By Prof. Thomas Carnelley.)—The truth of the periodic law of the chemical elements is now generally allowed by most chemists. Nevertheless, but little has been done towards attaining a reasonable explanation of the law. This prompts the author to offer a few suggestions on this subject. Even long before the discovery of the periodic law many chemists had pointed out certain numerical relationships existing between the atomic weights of bodies belonging to a given group, and had, hence, supposed that the elements belonging to the several natural groups were not primary, but were made up of two or more simpler elements. These conclusions, however, were more or less fragmentary and referred only to particular groups of elements. In the light of the periodic law the author has made a general extension of the fragmentary conclusions of Dumas, and has brought that law into juxtaposition with an extended generalization of the analogy of the elements with the hydrocarbon radicals. A careful consideration of the relations between certain physical properties and the atomic weights of the elements leads almost irresistibly to the conclusion that the elements are analogous to the hydrocarbon radicals in both form and function. This is a conclusion which if true would further lead us to infer that the elements are not elements in the strict sense of the term, but are built up of (at least) two primary elements, A (=carbon at. wt. 12) and B (æther, at. wt.—2), which by their combination produce a series of compounds (viz, our present elements) analogous to the hydrocarbon radicals. If this theory be true the periodic law follows as a matter of course, and we should therefore be able to represent the elements by some such general formula as $An\ B\ 2n+(2-x)$, analogous to that for the hydrocarbon radicals $C_n H_{2n+(2-x)}$ in which n=the series and x the group to which the element or hydrocarbon radical belongs. Assuming the truth of the theory here advanced, it is interesting to observe that whereas the hydrocarbons are compounds of hydrogen and carbon, the chemical elements would be composed of carbon with æther, the two sets of bodies being generated in an exactly analogous manner from their respective elements. There would, hence, be three primitive elements, viz, carbon, hydrogen, and æther. Finally, this theory would remove the chief objections which have been urged against the periodic law, whilst the existence of elements of identical atomic weights and isomeric with one another would be possible. May not Ni and Co, Ru and Rh, Os and Ir, and some of the rare earth metals be isomers in this sense? (Report B. A. A. S. in *Nature*, XXXII, 539.)

Relations between the Atomic Weights and the Physiological Functions of the Elements (by Fausto Sestini).—A study of the following table containing the elements entering into the formation of the organic matter of plants, shows that no element having an atomic weight higher than 56 takes a direct part in producing organic bodies:

	Indispensable.	*Useful.*
Electro-negative	C=12; N=14; O=16; P=31; S=32	Si=28; Cl=35·5.
Electro-positive	H=1; Mg=24; K=39; Ca=40; Fe=56	Na=23; Mn=55.

Among the remaining elements of the first four groups of the periodic system which occur in the ashes of certain plants are Al=27·3 in lycopodium and equisetum, Li=7 in tobacco and vines, Fl=19 in many higher plants, Cu=63, Zn=65, and Br (also I) in algæ. The elements following copper up to uranium act like poison upon plants and animals. The soluble compounds of most of the elements having higher atomic weights than 56 coagulate albumen, exert a very injurious influence on animals, and act to a certain extent as antiseptics. (*Gazz. chim. italiana*, XV, 107.)

On the Unit used in Calculating the Atomic Weights (by Lothar Meyer and Karl Seubert).—The controversy arising immediately after the proposal of Dalton's atomic theory, as to the unit upon which the numerical values of the atomic weight should be based has for half a century divided chemists into two schools. While Dalton and, later, Leopold Gmelin, from theoretical and philosophical considerations, chose the smallest atomic weight, that of hydrogen, as the measure of all the rest, Wollaston and Berzelius chose that of oxygen, partly because they did not place so high a value on theoretical views, and partly on the purely practical ground that many elements can be compared directly with oxygen, whereas they can be only indirectly compared with hydrogen. When the Dalton unit, the hydrogen atom, gradually obtained the upper hand, the old controversy appeared to have been laid aside, and consequently it was to be hoped that the recent more exact investigations of the laws which govern the numerical values of the atomic weights would be directed from the same point of view. This hope, however, has unfortunately not been fulfilled, as the old Wollaston-Berzelius unit has lately again come into use in a different—and as we believe—more dangerous form.

As is well known, J. S. Stas has from his own observation as well as those of others deduced as the most highly probable result that the atomic weight of oxygen is not quite sixteen times as great as that of hydrogen, but on the contrary is about $\frac{1}{400}$ of its value less than 16 H. That is when H=1, O=15·96. Many chemists, however, content themselves with numerical values founded on the more simple ratio of H : O=1 : 16, regarding the difference of $\frac{1}{400}$ as of very little practical consideration. And the hope that the old controversy over the choice of the unit would disappear upon a recalculation of the atomic weights has unfortunately not been fulfilled. The desire to do away with the unit O=100 is universal; all chemists prefer referring atomic weights to hydrogen, but they do not agree as to the way in which this is to be done. Some refer all atomic weights to O=16, when H=1·0023, and others to H=1. In consequence of these different views all the other atomic weights fluctuate to the extent of about $\frac{1}{4}$ per cent. of their value, a very undesirable state of affairs, leading to confusion and perplexity. The authors maintain that the real cause prompting the adoption of O=16 is a secret fondness for Prout's hypothesis.

The authors admit that the error introduced by making O=16 is much smaller than the unavoidable errors of observation so far as *inorganic* compounds are concerned, but they show that in the analysis of *organic* compounds it is quite otherwise. From a table showing the percentages of hydrogen and carbon in the paraffins containing 30 and 31 carbon atoms and their derived alcohols and acids, it is evident that the variations in the calculated percentages of carbon dioxide reach the tenths of a per cent., a difference often greater than that obtained from two adjacent hydrocarbons in a homologous series.

With the aid of a second table, in which calculations are made on the two suppositions that O=16, and O=15·96, the authors show that according to the former a given analysis would lead to the formula $C_{25}H_{52}$, but according to the latter the formula would be $C_{27}H_{56}$. Of course in such a case no one would determine the formula by analysis alone. In conclusion, the authors say: "We are all convinced that the relation under consideration (and thereby every other atomic weight referred to H=1) is not accurate to the thousandth part of its value. Let us accept it without artificial interpretations and wait till the future for its further proof and confirmation by experimental methods." (*Ber. d. chem. Ges.*, XVIII, 1089, and *Am. Chem. J.*, VII, 96.)

Prout's Hypothesis and the Atomic Weight of Silver (by Lothar Meyer and K. Seubert).—The calculation of the atomic weights of many of the elements depends, as is well known, upon that of silver, so that the sharpest possible determination of this is desirable in order to obtain accurate results, without which a discussion of Prout's hypothesis, as far as this is concerned with facts, is unprofitable. For this reason J. S. Stas, in his masterly investigations, used the utmost care in determining the stoichiometrical relations between silver and oxygen. Dumas, in 1878, showed that oxygen was contained in pure silver which had been fused with borax and saltpeter. The authors have studied the influence which the slight percentage of oxygen may have exerted on Stas' silver determinations, and conclude that the latter were not appreciably influenced by the occluded oxygen. The authors maintain that the most accurate determinations of atomic weights of the elements all contradict Prout's hypothesis in its characteristic original conception; it must therefore be looked upon as having been disproved by experiment. (*Ber. d. chem. Ges.* XVIII, 1098, and *Am. Chem. J.*, VII, 104.)

Re-determinations of Atomic Weights.

Element.	Atomic weight.	Authority.	Reference.
Cerium	141·1	Crookes	Chem. News, LII, 302.
Lanthanum	138·3	....do	Do.
Carbon [O=16]	12·0	van der Plaats	Comptes rendus, C, 52.
Phosphorus [O=16]	31·0	....do	Do.
Tin [O=16]	118·07	....do	Do.
Zinc [O=16]	65·17	....do	Do.
Titanium	48·01	T. E. Thorpe	Chem. News, LI, 46.
Bismuth	208·16	R. Schneider	J. prakt. Chem., XXX.
Glucinum	9·1	Humpidge	Chem. News, LI, 121.
Samarium	150·02	Cleve	Chem. News, LI, 145.
Didymium	142·3	....do	Chem. News, LII, 227.
Cerium [O=16]	140·22	Brauner	J. Chem. Soc., 1885, 879.

Physical Conditions Dependent upon Temperature.—The experiments of French and of Russian chemists in liquefaction of gases, and the extraordinary temperatures obtained, excite so much interest that we here transcribe a somewhat extended table of temperatures with attendant phenomena. The table was compiled by Mr. J. J. Coleman, and presented by him to the Philosophical Society of Glasgow, March 18, 1885, in connection with his paper on the "Liquefaction of Gases, and other Effects of Extreme Cold." (See *Chem. News*, LI, 174.)

Fahr.	Cent.	Physical conditions dependent on temperature.	Atmospheres.
+698	+370	Critical point of water	195·5
311	155·4	Critical point of sulphuric anhydride	78·9
285	141	Critical point of chlorine	83·9
266	130	Critical point of ammonia	115
212	100·2	Critical point of sulphuretted hydrogen	92
98	37	Critical point of acetylene	68
95	35·4	Critical point of nitrous oxide	75
89	31·9	Critical point of carbon dioxide	77
50	10·1	Critical point of ethylene	51

Fahr.	Cent.	Physical conditions dependent on temperature.	Authority.
+ 32	0	Nitrous oxide boils at 32 atmospheres pressure	Faraday.
+ 32	0	Carbon dioxide boils at 36 atmospheres pressure	Do.
+ 14	— 10	Sulphur dioxide boils	Do.
+ 15	— 10·5	do	Bunsen.
+ 10	— 23	Methyl chloride boils	Regnault.
— 10	— 23	Carbon dioxide boils at 19.38 atmospheres pressure	Faraday.
— 20	— 29	Sulphur dioxide boils in current dry air	Pictet.
— 20	— 29	Carbon dioxide and oxygen, air and nitrogen compressed to 300 atmospheres in glass tubes and expanded suddenly show liquefaction.	Cailletet.
— 26	— 32	Alcohol containing 52 per cent. water freezes	Pictet.
— 29	— 33·6	Chlorine boils	Regnault.
— 29	— 33·7	Ammonia boils	Bunsen.
— 31	— 35	Commercial paraffin oil (sp. gr. 0.810) freezes	Coleman.
— 40	— 40	Nitrous oxide boils at 8.71 atmospheres pressure	Faraday.
— 40	— 40	Carbon dioxide boils at 11 atmospheres pressure	Do.
— 40	— 40	Ethylene boils at 13.5 atmospheres pressure	Do.
— 53	— 47	Holland gin and French brandy freeze	Coleman.
— 60	— 51	Nitrous oxide boils at 5 atmospheres pressure	Faraday.
— 60	— 51	Carbon dioxide boils at 6.75 atmospheres pressure	Do.
— 60	— 51	Ethylene boils at 9 atmospheres pressure	Do.
— 62	— 52	American petroleum (sp. gr. .790) freezes	Coleman.
— 62	— 52	Extra-strong whisky and rum freeze	Do.
— 62	— 52	Alcohol containing 40 per cent. water freezes	Do.
— 80	— 61·8	Sulphydric acid boils	Regnault.
— 80	— 62	Nitrous oxide boils at 3 atmospheres pressure	Faraday.
— 80	— 62	Carbon dioxide boils at 3.75 atmospheres pressure	Do.
— 80	— 62	Ethylene boils at 6.5 atmospheres pressure	Do.
— 99	— 73	Critical point of marsh gas, 56 atmospheres pressure.	Wroblewski.
—103	— 75	Liquefied ammonia freezes	
—103	— 75	Alcohol containing 20 per cent. water freezes	Coleman.
—108	— 78	Carbon dioxide boils	Faraday and Regnault.
—112	— 80	Solid sulphurous anhydride melts	Mitchell.
—123	— 86	Nitrous oxide boils	Faraday.

Fahr.	Cent.	Physical conditions dependent on temperature.	Authority.
—123	— 86	Marsh gas boils at 40 atmospheres pressure	Wroblewski.
—128	— 87·9	Liquid nitrous oxide boils	Regnault.
—144	— 98	Marsh gas boils at 25 atmospheres pressure	Wroblewski.
—152	—102	Amyl alcohol, an oily liquid	Olzewski.
—152	—102	Silicon fluoride, a white mass	Do.
—152	—102	Arsenetted hydrogen liquid	Do.
—152	—102	Hydrochloric acid boils	Do.
—152	—102	Chlorine in orange crystals	Do.
—152	—102	Ethylene boils	Wroblewski.
—154	—103	do	Olzewski.
—166	—110	Solid carbon dioxide and ether in vacuo	Faraday.
—171	—113	Critical point of oxygen, 50 atmospheres pressure	Wroblewski.
—171	—113	Marsh gas boils at 16 atmospheres pressure	Do.
—175	—115	Solid carbon dioxide in vacuo, 25^{mm} pressure	Dewar.
—175	—115	Hydrochloric acid a solid	Olzewski.
—177	—116	Carbon disulphide a solid	
—180	—118	Arsenetted hydrogen in white crystals	Do.
—193	—125	Nitrous oxide boils in vacuo	Dewar.
—200	—129	Ether solidifies	Olzewski.
—202	—130	Absolute alcohol a solid	
—209	—134	Amyl alcohol a solid	Do.
—218	—139	Ethylene boils in vacuo	Do.
—219	—139·5	Critical point of carbon monoxide, 35.5 at pressure.	Do.
—220	—140	Critical point of air, pressure 39.0 atmospheres	Do.
—220	—140	*Calculated* temperature of carbon dioxide snow in vacuo.	Pictet.
—220	—140	Hydrogen compressed to 650 atmospheres and pressure released produces momentary liquefaction and solidification.	Do.
—220	—140	Oxygen compressed to 320 atmospheres and pressure released produces momentary liquefaction.	Do.
—231	—146	Critical point of nitrogen, 35 atmospheres pressure.	Olzewski.
—238	—150	Ethylene boils in vacuo	Do.
—238	—150	Carbon dioxide boils at 20 atmospheres pressure	Do.
—242	—152	Atmospheric air boils at 20 atmospheres pressure	Do.
—247	—155	Marsh gas boils	Wroblewski.
—299	—184	Oxygen boils	Do.
—312	—191·4	Air boils	Olzewski.
—312	—191·2	do	Wroblewski.
—315	—193	Carbon monoxide boils	Do.
—317	—194	Nitrogen boils	Olzewski.
—336	—205	Air boils in vacuo	Do.
—348	—211	Carbon monoxide solidifies	Do.
—351	—213	Nitrogen boils in vacuo	Do.
(?)	(?)	Hydrogen at 100 to 200 atmospheres liquefies to colorless drops (in glass tubes 0.2^{mm} diameter surrounded by oxygen boiling in vacuo).	Wroblewski and Olzewski.
—355	—215	*Calculated* boiling point of hydrogen	E. J. Mills.
—460	—273	Absolute zero	

Compare note on solid nitrogen under the head "Inorganic."

Anomalies in the Boiling Points of the Chloroaceto-nitrils and their Derivatives (by Hermann Bauer).—As a rule the replacement of hydrogen by chlorine or by oxygen lowers the volatility of organic compounds not inconsiderably, but in certain cases an opposite effect results. Such an abnormal effect is especially noticed in cyanogen compounds, the volatility of which is usually increased by the introduction into the molecule of negative radicals, and this occurs even when the molecular weight is greatly increased. Chlorocyanogen and dicyanogen, for example, are more volatile than hydrocyanic acid:

$H-CN$ boils at +26°
$Cl-CN$ boils at +15°
$NC-CN$ boils at −21°

and cyanethyl boils at 96°, higher than cyanacetyl, which boils at 93° C. The chloronitrils exhibit similar peculiarities. These and similar facts prompted the author to examine the influence on the boiling point of introducing atomic groups in the place of the chlorine in those bodies in which the chlorine itself produces no change or marked change in the volatility. To this end the author prepared the four nitrils named below; their formula, and boiling points compared with trichloracetonitril, are given in the table:

Name.	Formula.	B. P. °	Difference.
Trichloracetonitril	CCl_3-CN	84	
Dichlormethoxylacetonitril	CH_3O-CCl_2-CN	148	−64
Dichlorethoxylacetonitril	$C_2H_5O-CCl_2-CN$	161	−13
Dichlorpropoxylacetonitril	$C_3H_7O-CCl_2-CN$	182	−21
Dichlormonoisobutoxylacetonitril	$C_4H_9O-CCl_2-CN$	196	−14

Whence it appears that the replacement of chlorine by methoxyl raises the boiling point 64°, and beyond this the boiling point increases with each addition of the carbon group in about the same ratio as in homologous compounds of like character.

In the compounds cited below, an unusual elevation of the boiling point occurs when oxymethyl enters.

Name.	Formula.	B. P.	Name.	Formula.	B. P.
Phosgene	$CO\left\{\begin{matrix}Cl\\Cl\end{matrix}\right\}$	+ 8°	Carbonic methyl-ether.	$CO\left\{\begin{matrix}OCH_3\\OCH_3\end{matrix}\right\}$	91°
Chlorocarbonic-methyl ether.	$CO\left\{\begin{matrix}Cl\\OCH_3\end{matrix}\right\}$	67°			
Chloroform	$CHCl_3$	61	Orthoformic methyl ether.	$CH(OCH_3)_3$	102°
Cyanchloride	$NCCl$	15.5	Cyanomethyl ether.	$NCOCH_3$	43–45
Trichloracetonitril	$NC-CCl_3$	84	Dichlomethoxylacetonitril.	$NC-CCl_2OCH_3$	148

In some cases the boiling point rises regularly 20° for each CH_2 introduced into the compound.

Name.	Formula.	B. P. °
Dichlorpropoxylacetonitril	$CCl_2(OC_3H_7)CN$	183
Monochlordipropoxylacetonitril	$CCl(OC_3H_7)_2CN$	200
Tripropoxylacetonitril	$C(OC_3H_7)_3CN$	218
Dichlorisobutoxylacetonitril	$CCl_2(OC_4H_9)CN$	195

In other cases a notable elevation of boiling point ensues when chlorine is replaced by ethoxyl.

Name.	Formula.	B. P. °
Phosgene	$CO—Cl_2$	+ 8
Chlorocarbonicethyl ether	$CO—ClO—C_2H_5$	94
Carbonicdiethyl ether	$CO—(OC_2H_5)_2$	126
Chloroform	$CHCl_3$	61
Orthoformicethyl ether	$CH—(OC_2H_5)_3$	146
Carbontetrachloride	CCl_4	77
Orthocarbonicethyl ether	$C—(OC_2H_5)_4$	159
Trichlorethane	CH_3CCl_3	74·5
Orthoaceticethyl ether	$CH_3C—(OC_2H_5)_3$	142
Cyanogen chloride	$NC—Cl$	15·5
Isocyanicethyl ether	$NC—OC_2H_5$	60
Tricyanogen chloride	$N_3C_3Cl_3$	190
Isocyanuricethyl ether	$N_3C_3—(OC_2H_5)_3$	276
Trichloracetonitril	$NC—CCl_3$	84
Dichlorethoxylacetonitril	$NC—CCl_2OC_2H_5$	161

In the following, however, we have an exception to the rule:

Name.	Formula.	B. P. °
Monochlordiethoxylacetonitril	$NC—CCl(OC_2H_5)_2$	161
Triethoxylacetonitril	$NC—C(OC_2H_5)_3$	161

It is evident that an exchange of chlorine methoxyl in many cases produces no change in the boiling point, and in some instances chlorine is equivalent to the ethoxyl group. This is true of the bodies prepared by the author; when once the atom of chlorine is replaced by ethoxyl the exchange of a second atom does not further influence the boiling point. (*Liebig's Annalen*, CCXXIX, 163.)

Radiant-Matter-Spectroscopy; Samarium.—Mr. William Crookes has continued his remarkable researches in the entirely original field of radiant-matter-spectroscopy. The results obtained as respects yttrium were noticed in our report for 1883. In a paper read before the Royal Society June 18, 1885, Mr. Crookes details the results of a study of the beautiful spectrum characterized by a strong red and a double orange band, and which proves to be peculiar to samarium.

This double orange band spectrum was first observed by him in 1881, and his laborious researches have been uninterruptedly pursued since that date; the extreme sensitiveness of the new method of testing acted as a drawback rather than a help, except that the persistency of the phenomena observed increased confidence in its reliability. To the inexperienced eye one part of the "orange band" substance in ten thousand gives as good an indication as one part in ten, and by far the greater part of the chemical work undertaken in the hunt for the spectrum-forming element was performed upon material which later knowledge showed did not contain sufficient to respond to any known chemical test. Except in few instances, as water analysis and the detection of poisons, chemistry takes little account of traces, and when an analysis adds up to 99·99 the odd 0·01 per cent. is conveniently put down to "impurities," "loss," or "errors of analysis." When however the 99·99 per cent. constitutes the impurity and this exiguous error 0·01 is the precious material to be extracted, and when, moreover, its chemistry is absolutely unknown, the difficulties of the problem become enormously enhanced. The author was therefore obliged to build up a new chemistry, and after six months' work he obtained the earth didymia in a state which most chemists would call absolutely pure, for it probably contained not more than one part of impurity in 500,000 of didymia. But this one part in half a million, profoundly affected the character of didymia from a radiant matter-spectroscopic point of view, and the persistence of this very minute quantity of interfering impurity entailed another six months' extra labor to eliminate these final traces, and to ascertain the real reaction of didymia pure and simple. The earth formerly called didymia proved to be a mixture of didymia and samaria. During the long process of purification the 1,000 grams dwindled away bit by bit until less than one-half a gram remained of the pure material. Didymia thus purified shows no trace of the orange double band, which is characteristic of samarium, an element discovered in 1879 by Lecoq de Boisbaudran.

The earths ceria, lanthania, didymia, and samaria possess in their purest state the following characters: Ceric oxide is almost pure white; in strong solution it has no absorption spectrum. The atomic weight of the metal was taken and found to be 141·1. Ceria gives no orange band spectrum in the radiant-matter tube. Lanthana is snow white, and the metal was found to have an atomic weight of 138·3. It gives no orange band spectrum when absolutely free from samaria. Samaria is white, with the faintest possible tinge of yellow; its absorption spectrum is much more feeble than the spectrum of didymium. Pure samaric sulphate by itself gives a very feeble phosphorescent spectrum. When however the samaria is mixed with lime before examination in the radiant-matter tube, the spectrum is very beautiful, consisting essentially of three bright bands—red, orange, and green—these being nearly equidistant, and the orange being the brightest. With a narrower slit the orange and green bands are seen to be double, with faint wings.

The spectrum of samaria becomes highly modified by mixing with the earth other metallic oxides. Mr. Crookes divides these modified spectra into three groups; for particulars of each, with diagrams of each type, we refer to the original paper. In a mixture of samaria and yttria the former possesses a remarkable power of obliterating the spectrum of the latter; this holds even in a mixture of 43 parts samaria and 57 parts yttria. The delicacy of the spectrum test for samarium is extraordinary; a mixture of 1 part of samarium with 1,000,000 parts of calcium still exhibits a feeble spectrum of samarium; in a mixture of 1 to 2,500,000 parts the spectrum of samarium is nearly imperceptible.

A striking feature in the spectra of various mixtures of samaria and yttria is a brilliant and sharp orange line $\frac{1}{\lambda_2}2693$. So long as this bright line is a component of the spectrum the other bands manifest decidedly less intensity, and many of them are suppressed. The profound modification in the spectra of samaria and yttria developed by their mixture is undoubtedly without precedent in spectrum analysis. Mr. Crookes remarks in conclusion that the many anomalies unearthed in these researches teach that inferences drawn from spectrum analysis *per se* are liable to grave doubt, unless at every step the spectroscopist goes hand in hand with the chemist. Spectroscopy may give valuable indications, but chemistry must after all be the court of final appeal. (*Chem. News*, LI, 301.)

A New Kind of Metallic Spectra; Possible New Elements.—At the meeting of the French Academy of Sciences on June 8, 1885, M. Lecoq de Boisbaudran requested that a sealed packet which he had deposited June 30, 1884, might be opened. The packet was opened by the permanent secretary during the meeting and contained a note of which the following is a condensation. When the electric spectrum of a solution with a metallic base is produced, it is customary to make the outside platinum wire (whence the induction spark strikes) positive, the liquid consequently forming the negative pole. If the direction of the current be reversed, the metallic rays, due to the free metal or to one of its compounds, are scarcely visible or quite invisible, at all events so long as the exterior platinum wire now forming the negative pole is not coated with a deposit. In examining the rare earths belonging to the didymium and yttrium family, the writer observed with many of the preparations the formation of spectrum bands, nebulous but sometimes tolerably brilliant, having their origin in a thin layer of a beautiful green color, which was seen to appear at the surface of the liquid (a solution of a chloride) when it was rendered positive. The principal bands are six in number, situated as follows: $\lambda 620\frac{1}{2}$, $\lambda 585\frac{3}{4}$, $\lambda 573$, $\lambda 543\frac{1}{5}$, $\lambda 487$, $\lambda 476\frac{1}{2}$; some of these are nebulous and broad. That at $543\frac{1}{5}$ is probably not due to any known element, unless it proves to be due to holmium. That at 573 is also probably due to a new element. The latter yet unisolated body the author designates provisionally by $Z\alpha$, and the former by $Z\beta$.

M. Lecoq de Boisbaudran regards his "reversion spectrum" as physically analogous to the phosphorescent spectra obtained by Mr. Crookes at the positive pole in his high vacuum tubes containing certain compounds of yttria. [See our Report for 1883.]

To this note in the sealed packet the French chemist added the following: "I have not yet finished the very long work undertaken in the hope of determining the nature of the above-described phosphorescent spectrum. This spectrum is now recognized as identical with that ascribed to pure yttria by Mr. Crookes, and which this savant obtained under experimental conditions very different from mine. Nevertheless, my latest observations lead to the conclusion that yttria is not the cause of the spectrum bands observed. In my fractionations the phosphorescence spectrum regularly gets weaker as I advance towards the yttria end. With almost pure yttria the phosphorescence bands show themselves faintly or not at all, while they are brilliant with the earths which do not give, by the direct spark, the rays of yttrium to an appreciable extent. The prodigious sensitiveness of Mr. Crookes' reaction, which detects a millionth part of his purified yttria, makes very singular this divergence which I am obliged to point out between the conclusions of the eminent English chemist and myself." - - - "I should acknowledge here that Mr. Crookes was the first to see the phosphorescence spectrum of samarium." (*Comptes rendus*, C, 1437, and *Chem. News*, LII, 4.)

Quantitative Determination of Lithium by the Spectroscope.—L. Bell has found the following method gives good results: A standard solution was made from lithium carbonate converted to the chloride, containing .0265^{mgm} of Li_2O per cubic centimeter. Of this 10^{cc} were taken, diluted till the spectral line was just on the point of vanishing and the volume noted. Then the solution to be estimated was diluted to the same point and its volume compared with that of the standard, when a simple proportion gave the amount of Li_2O present. A very small loop of platinum wire should be used and applied to the same part of the Bunsen flame. The method is applicable to the analysis of lithium minerals, and examples are given. The method is useful also in case of thallium and such other elements as give distinct lines in the spectroscope. (*Am. Chem. J.*, VII, 35.)

Action of Light on Iodoform in Solution.—E. Fabini has observed that a solution of iodoform in benzine becomes bright red when exposed to direct sunlight for ten to twenty minutes, whereas in the dark it remains colorless. If a solution prepared in the dark is suddenly exposed to the rays of the sun it immediately turns to a splendid red color, and iodine is precipitated. Further experiments with solutions of iodoform in ether and in oils shows it to be very sensitive to light, being thereby reduced. (*Pharmaceutische Post.*)

On the Action of Light in Chemical Reactions (by D. Amato).—The author, in studying the action of light and of heat in chemical reactions, has obtained results of great interest; he shows that many of the decompositions and combinations attributed to the action of light exclusively are in reality due to light and heat, or to the latter agent only. The decomposition of liquid phosphine is generally attributed to light, but the author shows that it can be exposed to direct sunlight at 10° without a trace of decomposition. Heat alone without light is inactive.

A mixture of chlorine and hydrogen can be exposed with impunity to sunlight if cooled to —12° C.; a temperature of 29° is not able to effect combination of the gases without sunlight. Chloride of silver requires both heat and light for its decomposition, and Fehling's solution is not changed by light alone; if organic dust be excluded the solution will keep indefinitely when exposed to full sunlight. (*Gazetta chimica italiana*, XIV, 57.)

INORGANIC.

Manufacture of Oxygen and of Ammonia from the Atmosphere.—The well-known process of extracting oxygen from the atmosphere by means of baryta has never been a commercial success, because after a while the baryta becomes inactive, owing probably to its absorption of carbonic acid from the air. At the "Inventions Exhibition," held during the summer months in London, the brothers Brin exhibited an improvement on the old process which promises to be very valuable. The air is freed from carbonic acid and water by caustic soda and then passed over barium oxide, heated to a temperature not above 600° C., in iron retorts. The temperature is regulated by a pyrometer, which controls also the supply of gas to the furnace. Under these conditions the oxygen of the air is absorbed by the baryta, barium peroxide being formed. The nitrogen which appears to be very pure is collected separately for use in the production of ammonia. On heating the peroxide of barium to full redness pure oxygen is given off. At this stage of the process powerful pumps are set in operation and make a partial vacuum in the retorts. The operations are continuous, and so long as the baryta is kept anhydrous and free from carbonic acid the same quantity will apparently last an indefinite time. The most interesting and perhaps the most useful part of the invention of the Brin Brothers is the production of ammonia by a very direct process. The nitrogen obtained as above and moistened by passing through water, is passed over a mixture of baryta, with charcoal heated to about 300° C. Carbonate of ammonia is thus obtained, the water being decomposed under the conditions named, its hydrogen combining with the nitrogen and its oxygen with the carbon. The ammonium compound is formed in considerable amount. (*Nature*, XXXII, 354.)

Solid Nitrogen; Lowest Known Temperatures.—K. Olszewski in a previous memoir describes apparatus for obtaining very low temperatures by means of oxygen and of air evaporating in a vacuum. In a subsequent series of experiments the author has further introduced into his apparatus a second tube of very thin glass, and thus isolates the liquefied gases by a double gaseous stratum. The pressure and the temperature being greatly lowered he has been able to solidify nitrogen, carbon monoxide, formene, and nitrogen dioxide, and to determine at the same time the temperatures of solidification. Nitrogen solidifies at —214° under a pressure of 60 atmospheres; carbon monoxide at —207° under 100^{mm} pressure; formene at —185°·8 under 80^{mm} pressure; and nitrogen dioxide at —167° under 138^{mm} pressure. The latter forms a colorless liquid. By reducing the pressure of solid nitrogen down to 4^{mm} of mercury he has succeeded in obtaining the lowest temperature known, —225° C. (—373° F.). *Comptes rendus*, C: 350 and 940.

Separation of Liquefied Air into Two Distinct Liquids (by S. Wroblewski).—The laws of the liquefaction of air are not those of the liquefaction of a simple gas. If at first sight air presents itself in such a manner that it is permissible to speak of the critical point of air, this depends merely on the slight difference which exists between the curves of tension of watery vapor, of oxygen and of nitrogen. The author obtained air as two distinct liquids separated by a perfectly visible meniscus, as follows: After having liquefied at —142° a quantity of air in the tube of his apparatus, he allows such a quantity of gaseous air to enter the tube that the pressure of the gas is equal to 40 atmospheres and its optical density equal to that of the liquid. The meniscus of the liquid disappears entirely. He then slowly diminishes the pressure, and at the moment when the gauge shows a pressure of 37·6 atmospheres a new meniscus appears at a point of the tube much higher than that occupied by the meniscus that has disappeared. A few moments afterward the old meniscus returns to the point where it disappeared, and at this moment two liquids are distinctly recognized and remain separate for some seconds. The lower liquid contains 21.28 vols. per cent. of oxygen, and the upper 17·3 to 18·7 per cent. (*Comptes rendus*, CI, No. 13.)

Solutions of Ozone and the Chemical Action of Liquid Oxygen.—At the Aberdeen meeting of the British Association for the Advancement of Science, Professor Dewar gave a description of the apparatus and method employed by him in the liquefaction of such gases as oxygen, &c., and after discussing the conditions required for the successful conversion into the liquid of the gases formerly called permanent, he gave an account of some experiments with liquid oxygen. At —130° liquid oxygen loses the active characters possessed by this element in the gaseous state; it is without action on phosphorus, sodium, potassium, solid sulphuretted hydrogen, and solid hydriodic acid. At very low temperatures other substances are similarly without action on each other; thus liquid ethylene and solid bromine may be brought in contact without any action taking place, whereas gaseous ethylene and liquid bromine unite directly at the ordinary temperatures.

Hautefeuille and Chapuis, by subjecting a mixture of carbonic anhydride and ozone to great pressure, obtained a blue liquid, the color of which is due to ozone. If ozonized air be passed into carbon disulphide at −100° the liquid assumes a blue color, which disappears if the temperature be allowed to rise, and at a certain point a decomposition, resulting in the production of sulphur, takes place. The best solvent for ozone is a mixture of silicon tetrafluoride and Russian petroleum. These solutions of ozone are without action on metallic mercury and silver. (*Nature*, XXXII, 540.)

Combustion in Dried Gases (by H. Brereton Baker).—It will be remembered that, in 1880, Mr. H. B. Dixon demonstrated that carbon monoxide and oxygen, if perfectly pure and absolutely dry, do not unite when subjected to the electric spark, but that the introduction of a little moisture causes an explosion. Led by these experiments, Mr. Baker has investigated the question whether moisture is necessary for the combustion of carbon and of phosphorus in oxygen. The purified materials were sealed up in bent hard-glass tubes with oxygen and phosphoric anhydride. At intervals of one, two, four, up to sixteen weeks the contents of the tubes were heated and the character of the combustion compared with that of the same elements in moist oxygen. The results showed that the burning of carbon is much retarded by drying the oxygen to the extent possible with the arrangement adopted by the author. (*Chem. News*, LI, 150.)

On the Function of Water in the Combustion of Carbon Monoxide (by Moritz Traube).—As stated in the preceding section, Mr. Dixon proved that a mixture of perfectly dry carbon monoxide and oxygen is not exploded by the passage of electric sparks, and that the presence of a minute quantity of water suffices to determine the combination of the gases. Dixon supposed that the action of the water could be represented thus:

$$(1)\ CO+H_2O=CO_2+H_2$$
$$(2)\ 2H_2+O_2=2H_2O.$$

Moritz Traube confirms Dixon's experiments and goes further. He shows that a flame of carbon monoxide is extinguished when introduced into a perfectly dry atmosphere or into dry oxygen. On the other hand, he finds that carbon monoxide does not decompose water in complete absence of air or oyxgen; and secondly, that when moist carbon monoxide and oxygen are exploded together, hydrogen peroxide is an invariable product. Consequently, Dixon's equations do not correctly represent the action, and Traube suggests the following:

$$(1)\ CO+2H_2O+O_2=CO(OH)_2+H_2O_2$$
$$(2)\ CO+H_2O_2=CO(OH)_2$$
$$(3)\ 2CO(OH)_2=2CO_2+2H_2O.$$

When hydrogen is burned in moist oxygen, hydrogen peroxide always forms. Whether a perfectly dry mixture of hydrogen and oxygen could or could not be exploded by electric sparks cannot be regarded as settled; the author thinks that such a mixture would prove to be non-explosible. He regards the mutual action of hydrogen, oxygen, and water as in all respects comparable with that of carbon monoxide, oxygen, and water, or with that of zinc, oxygen, and water. The changes which occur in the explosion of moist hydrogen and oxygen are thus formulated:

$$(1)\ H_2+2H_2O+O_2=2H_2O+H_2O_2$$
$$(2)\ H_2O_2+H_2=2H_2O$$

The second reaction has been experimentally demonstrated by the author. (*Ber. d. chem. Ges.*, XVIII, 1890.)

Indications of the Existence of an Allotropic Modification of Nitrogen and Synthesis of Ammonia.—Under this title George Stillingfleet Johnson has published a pamphlet of theoretical and practical interest. He reviews the experiments of Donkin, Berthelot, Déhérain, and Maquenne, P. and A. Thénard, and H. St. Clair Deville, showing the production of ammonia and of its salts by the action of the silent discharge, or of electric sparks upon mixtures of atmospheric nitrogen and oxygen, of watery vapor and nitrogen gas, and of hydrogen, nitrogen, and hydrochloric acid. Mr. Johnson then repeats some of his earlier experiments on the synthesis of ammonia, and after carefully eliminating sources of error obtains results which lead him to infer that the gas evolved from hot solutions of ammonium nitrite contains an allotropic or active form of nitrogen, which differs from ordinary nitrogen in possessing the property of forming ammonia by direct synthesis with hydrogen in presence of heated spongy platinum, and which is converted into ordinary inactive nitrogen by the action of heat, precisely as ozone is converted into ordinary oxygen by the same agency.

In experimenting with atmospheric nitrogen the author failed to obtain ammonia by passing the nitrogen, recently heated and mixed with hydrogen through red-hot tubes in the presence of platinum sponge. But he did obtain ammonia from atmospheric nitrogen which had *not* been heated.

One of the most important experiments is thus described: Into an ordinary eudiometer tube full of mercury, pure nitrogen gas, obtained by any method, is introduced and measured. Next admit three times its volume of pure hydrogen gas and introduce into the gaseous mixture a fragment of wood charcoal previously ignited in hydrogen gas, or better, in a mixture of three volumes of hydrogen with one volume of nitrogen gas. Now pass the spark continuously through the wires of the eudiometer. About 4 to 6 *c. c.* of the mixture are combined and absorbed by the charcoal per hour, until finally the whole of the gas may be made to disappear; after which, if the charcoal be removed, it will be found impregnated with ammonia. (*Chem. News*, LII, 34.)

Reduction of Carbon Dioxide to Carbon Monoxide by means of Charcoal (by Alexander Naumann and Carl Pistor).—Water-gas, formed by passing steam over incandescent charcoal, contains, besides hydrogen and carbon monoxide, varying quantities of carbon dioxide, which is a hindrance to the economic uses of the water-gas. In the following research the authors examined the chemical reactions which take place under varying temperatures, and with different quantities of charcoal. The temperatures were determined by inserting in the heated tube (combustion tubing 82 centimeters long) substances having well-established melting points, such as lead chloride (501°), silver pyrophosphate (585°), silver (954°), &c.

Experiments determine that the lowest temperature at which the reduction of carbon dioxide to monoxide by charcoal begins lies between 530° and 585°, say 550°, provided the gas be passed not too rapidly and the charcoal layer be 66 centimeters long.

With a charcoal layer only 10 centimeters long a much higher temperature is necessary, between 634° and 703° C. The amount of carbon dioxide reduced increases with the rise of temperature. For the table giving results of eleven experiments under varying conditions, we refer to the original article. (*Ber. d. chem. Ges.*, XVIII, 1647.)

Preparation of Cyanogen in the Wet Way (by G. Jacquemin).—The usual process, by the action of a concentrated solution of cupric sulphate on a saturated solution of potassium cyanide is incomplete, only half the cyanogen being evolved. In the process of the author all the cyanogen of the potassium cyanide is obtained and the gas is pure.

Two parts of cupric sulphate dissolved in four parts of water are placed in a retort or in a flask, on a water-bath, and, by means of a stoppered funnel, a concentrated solution of one part of pure potassium cyanide is gradually introduced. The reaction begins violently at ordinary temperatures and when the evolution slackens the temperature of the water-bath is elevated to quicken it. Ten grams of chemically pure KCN give 850 c. c. of pure cyanogen. Commercial KCN gives the same result, but the gas sometimes contains traces of CO_2.

There are two processes for withdrawing the cyanogen of the copper cyanide. 1. Decant the liquid remaining in the retort or flask, wash by decantation, and add a slight excess of ferric chloride of 30° B., or higher. The action commences in the cold and a slight elevation of the temperature produces an abundant evolution of cyanogen. The ferric chloride passes to the state of ferrous chloride in transferring the copper cyanide to chloride, which sets free the cyanogen and forms cuprous chloride which turns to cupric chloride at the expense of the excess of persalt of iron. 2. Add to the washed copper cyanide some manganese peroxide and acetic acid. Heat slightly. Acetates of copper and manganese are formed and cyanogen is evolved. When the operation is ended the evolution tube is replaced by a receiver, sulphuric acid is added, and the mixture of the two acetates is distilled to collect the acetic acid, which is used again. (C. E. M. *from Comptes rend.*, C, 1005.)

On Potassium Chromocyanide and Hydrochromocyanic Acid (by H. Moissan).—Potassium chromocyanide is obtained in several ways: By the action of potassium cyanide on chromous acetate; by calcining a mixture of potassium carbonate, dried blood, and finely-pulverized chromium; by the action of potassium cyanide on chromous chloride in an apparatus filled with carbon dioxide, and by the action of potassium cyanide on chromous carbonate.

Potassium chromocyanide forms fine crystals of a light yellow color, which occur several centimeters in length; it is very soluble in water, insoluble in alcohol at 94°, ether and chloroform. Its specific gravity equals 1·71. The salt is anhydrous. It is permanent in the air at ordinary temperatures. In solution it does not give as a rule precipitates with acid salts of the metals. With ferrous salts it yields a red precipitate; with zinc and lead salts, a white precipitate; with silver, bismuth, and barium salts, a yellow precipitate. Its physiological action is similar to that of ferrocyanide of potassium. It has the composition K_2CrCy_3.

If dilute sulphuric acid be added to a concentrated solution of the salt, a white crystalline precipitate forms. This is the hydrochromocyanic acid, a very unstable body, decomposed in watery solution by acids. (*Ann. chim. phys.* [6], IV, 136.)

Notes on Nitrogen Trioxide and on Nitric Oxide.—Professor Ramsay, in a paper read before the chemical section of the British Association for the Advancement of Science, argued against the existence of gaseous nitrogen trioxide. He pointed out that the only criterion of the existence of this gas is the vapor density; NO_2 and NO mix without change in volume, and, therefore, no combination takes place. The vapor density of the first portion of the gas obtained by distilling liquid N_2O_3, corresponds to that which a mixture of N_2O_4, NO_2, and NO should have.

At the same place Professor Dewar made remarks on the molecular weight of nitric oxide. A comparison of the curve of liquefaction of nitric oxide with that of methane shows the pressure to increase more rapidly with the temperature in the case of nitric oxide than in other gases, a fact that appears to indicate that at low temperatures the molecule of nitric oxide is of greater complexity and probably exists as N_2O_2. (*Nature*, XXXII, 538 and 540.)

Reactions between Nitric Oxide and Oxygen under Varying Conditions (by G. Lunge).—The experiments described lead the author to the following conclusions: 1. In the dry state, nitric acid with an excess of oxygen combines to form N_2O_4 exclusively, or nearly so. 2. Dry nitric oxide and oxygen, with an excess of the former, yield a great deal of

N_2O_3 along with N_2O_4, both in a state of gas. 3. In the presence of water nitric oxide with an excess of oxygen is altogether converted into HNO_3. 4. If nitric oxide and oxygen meet in the presence of concentrated sulphuric acid there is neither N_2O_4 nor HNO_3 formed, even with the greatest excess of oxygen, but the reaction is—

$$2H_2SO_4+2NO+O=2SO_2(OH)(ONO)+H_2O;$$

that is, nitrosyl sulphate and water.

This last reaction has an important bearing on the theory of the manufacture of sulphuric acid. The author maintains that it is not, as generally assumed, the nitric oxide, NO, but the nitrogen trioxide, N_2O_3, which acts as the carrier of oxygen in the vitriol-chamber process. (*J. Chem. Soc., London, July*, 1885, p. 465.)

On the Reaction between Mercurous Nitrate and Nitric Oxide, and between Mercurous Nitrate and Nitrites (by Dr. Edward Divers and Tamemasa Haga).—It has been known for, perhaps, half a century that mercurous nitrate yields metallic mercury when treated with a solution of alkaline nitrite, and this reaction has always been regarded as one of oxidation of the nitrate by reduction of the mercury salt. The authors show this is incorrect. When, with exclusion of air, pure nitric oxide is passed into a solution of mercurous nitrate in dilute nitric acid, a precipitation of metallic mercury slowly takes place and hydroxyamine is formed in quantity, but no ammonia. Prolonged contact of the gas gives rise to beautiful long yellow prisms, while the hydroxyamine disappears from the mother liquor. This new yellow salt will be more fully described by the authors at a later date. The first stage of the reaction is thus formulated by these chemists:

$$(HgNO_3)_2+2NO=2(NO)NO_3+2Hg,$$

nitric oxide precipitating mercury from its salt. The nitrosyl nitrate, here assumed to form, will at once decompose with water and mercurous nitrate into hydroxyammonium nitrate and mercuric nitrate, thus:

$$4(HgNO_3)_2+8HNO_3+2(NO)NO_3=8Hg(NO_3)_2+2(HONH_3)NO_3.$$

An after reaction between mercuric nitrate and the nitric oxide follows, and the hydroxyamine is decomposed. (*Chem. News*, LII, 8.)

The Sulphur Compounds of Calcium (by V. H. Veley).—The main points in this paper are thus summarized by the author:

1. By the action of hydrogen sulphide on solid calcium hydroxide there is formed a calcium monosulphide, in accordance with the equation:

$$Ca(OH)_2+H_2S=CaS+2H_2O.$$

2. By the action of hydrogen sulphide on calcium hydroxide in aqueous solution there is formed calcium hydrosulphide, in accordance with the equation:

$$Ca(OH)_2+2H_2S+x Aq=Ca(SH)_2+2OH_2+x Aq.$$

3. Calcium hydroxy-hydrosulphide, $CaSH,OH$, absorbs carbon disulphide, with formation of unstable basic calcium thiocarbonates, decomposed slowly by hydrogen sulphide and readily by carbonic anhydride. (*J. Chem. Soc. Lond., July*, 1885, *p.* 478.)

Decomposition of Didymium; Praseodymium and Neodymium.—Dr. C. A. von Welsbach read a paper before the Vienna Academy of Sciences on June 18, in which he describes an alleged decomposition of the elementary substance known as didymium. This decomposition was effected by means of the double ammonium or sodium nitrates in presence of lanthanum. In spite of the different behavior of the constituent bodies many hundred fractional crystallizations were necessary for their separation. The two new elements in solution are distinguished by intense absorption bands, and share between them the absorption bands of the peculiar spectrum hitherto ascribed to didymium. The colors of the compounds differ; the salts of that element which approaches nearest to lanthanum are of a leek green; the salts of the other element are rose or amethyst red. The latter body forms the bulk of didymium.

Both colors are almost complementary, but the amethyst red is by far the more intense, so that a small quantity of the salts of this element causes the green color of the others to disappear. The atomic weights of the two new elements are according to preliminary determinations very different, and vary considerably from the value heretofore ascribed to didymium. For the first element the author proposes the name praseodymium (Pr), and for the second neodymium (Ne). The two elements, so far as has been observed, yield each only one series of salts derived from the sesquioxide. Praseodymium peroxide evolves chlorine on treatment with hydrochloric acid. (*Chemiker Ztg*, and *Chem. News*, LII, 49.)

Researches on the Complex Inorganic Acids (by Dr. Wolcott Gibbs).—Another and weighty instalment of his laborious researches was presented by Dr. Gibbs to the American Academy of Arts and Sciences early in June. Among other things, he shows that vanadic pentoxide unites with phosphoric or arsenic pentoxides in various proportions to form well-defined complex acids. Compounds of vanadic pentoxide, vanadic dioxide, and phosphoric or arsenic pentoxide may be formed possessing properties analogous to the corresponding compounds of tungsten and molybdenum. Compounds exist which contain pyrophosphoric and metaphosphoric acids in the place of orthophosphoric acid. Complex acids exist which contain two different modifications of phosphoric acid, as, for instance, metaphosphoric and orthophosphoric acids or oxides. The salts of a majority of these complex acids crystallize in well-defined forms. In a summary Dr. Gibbs catalogues the formula of not fewer than 72 new salts discovered and analyzed in the course of his prolonged investigations. (*Proceedings Am. Acad. Arts and Sciences*, XIX, 50.)

Sodium Orthovanadates and their Analogues (by Harry Baker).—Doubts expressed by Mendelejeff and by Rammelsberg as to the strict analogies between phosphorus, arsenic, and vanadium prompted the author to prepare and examine closely the sodium salts of tribasic orthovanadic acid. Trisodium phosphate and trisodium arsenate crystallize in hexagonal prisms with 12 molecules of water, and Roscoe describes the corresponding vanadate as acicular crystals with 16 molecules of water. The author finds, however, that a vanadate having 12 molecules of water ($Na_3VO_4.12H_2O$), and crystallizing also in hexagonal prisms, can be obtained without difficulty.

Besides the latter, there exist two salts containing 10 molecules of water, one of which crystallizes in the isomeric and the other in the hexagonal systems. A third salt, crystallizing in rhombic tables, was obtained by the author, but owing to the great difficulties experienced in separating it from its mother liquid the water estimation was not satisfactory; it probably has the formula $Na_3VO_4.8H_2O$. Phosphates and arsenates analogous to the three salts last named are not yet known. Sodium-vanadio-sodium-fluoride, $2Na_3VO_4.NaFl.19H_2O$, is also described by the author and its contents in water accurately determined as given.

In conclusion, the author finds the analogies between vanadium, arsenic, and phosphorus strongly confirmed by the results of his investigation. (*Liebig's Annalen*, CCXXIX, 286.)

Recovery of Gold and Silver from Metallic Iron (by Dr. J. C. Booth).—In the course of an interesting article on the "Smelting Furnace of the U. S. Mint," the author gives his experience as to the best plan for recovering metallic gold and silver from the iron grate-bars, tools, &c. Formerly the iron was alternately heated and hammered until the precious metals scaled off. This operation took the labor of one dozen men during three or more days of ten hours each, for the gold clings with great tenacity to the iron; nor was the method without loss. At present all the iron residues from the furnaces, even including the grate bars, are melted, and while quietly melted the heavier gold and silver settle out of the iron. When the mass is cold the precious metal is knocked off the bottom by a hammer as a single tough ring, with scarcely a trace of iron in it, while the iron above has never yielded a trace of gold or silver to the assayer. (*Jour. Am. Chem. Soc.*, VII, 159.)

An Electrical Furnace for Reducing Refractory Ores (by E. A. and A. H. Cowles).—These gentlemen, together with Prof. C. F. Mabery, have devised an electrical furnace on the incandescent principle. A column of fragments of well-calcined charcoal is embedded horizontally in finely-pulverized charcoal and covered by a layer of the same material coarsely broken, the whole being arranged in a box of fire-brick covered with perforated tile, and opened at the ends to admit two carbon electrodes an inch and a half in diameter. Through these is passed the current from a dynamo of 30 horse-power. By this arrangement such a tempertture is obtained that not only platinum-iridium may be fused, but the most refractory oxides, such as alumina, silica, &c., are reduced to their elements with formation of carbon monoxide.

The apparatus is especially used in the manufacture of aluminum bronze and of silicium bronze for commercial purposes.

The application of electricity to smelting is not so novel as commonly supposed. In 1853–'54, G. A. Pichon used an electric furnace in which ores of iron, mixed with one-hundredth of coke or charcoal, is fed between the poles of a series (two or more tiers) of large electrodes; fusion takes place and the metal and slag fall into a heated receiver below. (*Practical Mechanics' Journal*, VI, 257). In 1882, C. W. Siemens invented an electric furnace in which electrodes are arranged vertically one above another, the negative passing through the lid of the crucible into the metal to be melted, the other through the bottom of the crucible. The length of the arc is controlled automatically by the electro-motive force between the electrodes. This furnace was, however, for melting and not for smelting. (*Chem. News*, 1882, 163.)

The furnace of Messrs. Cowles and Mabery yields good results on a larger scale than those of others.

ORGANIC.

A Plea for the Empiric Naming of Organic Compounds (by Professor Odling).—Verbal translations of the structural formulæ assigned to organic compounds possess certain advantages as names for the several compounds. Thus, they are applicable to all organic compounds of which the structural formulæ are made out; they are the only sort of names applicable to complex isomeric compounds; and their use cannot be dispensed with wholly in the case of even less complex compounds. Notwithstanding these advantages structural names constitute unsuitable names for general use, more especially as applied to fundamental hydrocarbons, alcohols, and acids. They are objectionable for this use by reason of their length, complexity, and want of ready indicativeness, by the circumstance of their being based on conceptions of chemical constitution of a kind pointed out by experience as eminently liable to change, and by the further circumstance of their representing a one-sided, and so far an untruthful, notion of the bodies designated. Structural names expressing other than a distorted view of the constitution of all but a few of the most simple of organic bodies are impracticable by reason of their length and complexity. Hence, to avoid the distortion inseparable from the use of any single structural name for an organic body the only expedient is the assignment to each body, in proportion to its complexity, of an indefinite number of structural names—a proceeding almost tantamount to not assigning it any particular name at all. Although from their number and complexity organic bodies can only be designated by names which do in some measure describe and characterize them, the primary purpose of a name is undoubtedly to designate and not to describe. Accordingly, with a view to the prompt mental association of object with name, brief empiric names based on the origin and properties of bodies are, wherever practicable, to be preferred to structural names. Isomeric bodies may, to a large extent, be distinguished by means of significant letters or syllables prefixed to the name common to the different isomers. But the suggested use of the particular letters α, β. γ, each in a special sense, also a general resort to the particles "hydro," "oxi," and "hydroxi," as name components, and more especially the innovation of substituting the word "hydroxide" for the long-established word "hydrate," are practices open to grave objection. (Report of British Association for the Advancement of Science, in *Nature*, XXXII, 538.)

Ethyl-urethane, a new Hypnotic.—Carbamate of ethyl, or ethyl-urethane, $CH_2.C_2H_5.NO_2$, has been found to have the properties of a hypnotic. This compound is prepared by the action of aqueous ammonia on ethyl carbonate, or on ethylchloro-carbonate, and forms large transparent colorless crystals, which melt below 100° C., and distill at 180° without alteration. It is soluble alcohol, ether, and water, to which it communicates a taste suggestive of saltpeter.

Experiments with ethyl carbamate were first made on animals by Schmiedelberg; recently von Jaksch has given the drug to man in doses of about 15 grains in over 100 cases. He finds it acts chiefly on the brain, having no appreciable influence over the peripheral nerves. It seems to be, therefore, a pure hypnotic. It causes a quiet and seemingly normal sleep, leaving no unpleasant secondary effects. (*Deutsche Medicinal-Ztg., September* 14, 1885.)

Ethyl Compounds of Hypochlorous Acid (by Traugott Sandmeyer).—Ethyl hypochlorite, $ClOC_2H_5$, is easily obtained as follows: Chlorine gas is passed into a solution of sodium hydroxide (1 part) in water (10 parts), cooled by ice, until absorption no longer takes place. This furnishes free hypochlorous acid and sodium chloride.

$$NaOH+2Cl=NaCl+ClOH.$$

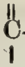
This is immediately placed in a separating funnel and mixed with one part of alcohol; the liquid becomes turbid and an oily layer separates. This oil is drawn off, washed, and dried in contact with calcium chloride. This ethyl hypochlorite forms a yellow, mobile, very volatile liquid of strong odor, and attacking the respiratory organs. It burns with a greenish flame; it can be distilled at 36° C. (Bar=752 *mm.*) without decomposition, but if a few drops are overheated in a test-tube it explodes violently. The liquid is very sensitive to sunlight, boiling vigorously a few minutes after exposure, and exploding. This action is not accomplished by the heat rays. Even in diffuse light, ethyl hypochlorite can be preserved only a few hours, eventually decomposing without explosion.

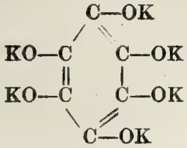
It acts very energetically on ammonia, phenol, aniline, and other organic bodies. Mixed with bromhydric acid it sets bromine free, and alcohol forms. The body was analyzed indirectly by determining the amount of iodine a given weight set free, the iodine being estimated volumetrically by sodium hyposulphite.

The author plans further researches on analogous bodies. (*Ber. d. d. chem. Ges.*, XVIII, 1767.)

On the Decomposition of the Terpenes by Heat (by William A. Tilden).—The author shows that experiments stated lead to the conclusion that the terpenes do not belong to the aromatic series, and are not formed on the benzene type. M. Berthelot, commenting on Tilden's paper, remarks he regards it of importance in confirming views which he (Berthelot) had announced fifteen years before. (*Ann. chim. phys.* [6], v, 120.)

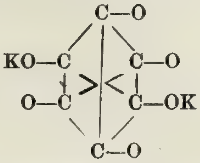
On Derivatives of Hexaoxybenzene and their Relation to Croconic and Rhodizonic Acid (by R. Nietzki and Th. Benckiser).—Starting with nitranilic acid, the authors have obtained a series of interesting bodies; a partial reduction of nitranilic acid yielded nitro-amido-tetraoxybenzene, and a more complete reduction gave diamido-tetraoxybenzene; the latter decomposes under certain conditions, forming a body having the formula $C_6H_{16}O_{14}$, which by reduction with tin and hydrochloric acid yielded the long-sought hexaoxybenzene $C_6(OH)_6$. This body proved to be identical with the trihydrocarboxylic acid obtained by Lerch from the action of potassium on carbon monoxide. On boiling the substance $C_6H_{16}O_{14}$, with water, it decomposed, with evolution of carbon dioxide, and yielded a solution which, neutralized with potash, gave on concentration orange yellow acicular crystals of potassium croconate $C_5K_2O_5$, first prepared in 1825 by Gmelin from the black residues of the manufacture of potassium according to the method of Wöhler and Brunner. From these facts it appears that Liebig, in his researches on the action of potassium on carbon monoxide, actually accomplished the direct synthesis of benzene derivatives from purely inorganic substances in the simplest manner.

This synthesis was successfully repeated by the authors, who obtained, besides potassium croconate, the rhodizonate long before discovered by Berzelius, Wöhler, and Heller. The latter salt was also obtained direct from dioxydichinoyl-sodium, thus establishing the identity of rhodizonic acid, carboxylic acid, and dioxydichinoyl. When CO combines with K it forms  $\overset{\|}{\underset{|}{\mathrm{C}}}\text{—OK}$, and six of these groups combine to form —



Hexaoxybenzene-potassium.

Partial oxidation of this substance yields—



Rhodizonate of potassium or potassium dioxydichinoyl.

(*Ber. d. chem. Ges.*, XVIII, 499 and 1833.)

Organo-Silicium Compounds in the Aromatic Series (by A. Polis).—Following the method devised by A. Michaelis in the preparation of the aromatic phosphines, arsines, and stibines, the author has made several silicium compounds in the aromatic series. Siliciumtetraphenyl, $Si(C_6H_5)_4$, is obtained by the action of one molecule of siliciumtetrachloride on four molecules of chlorbenzene in the presence of sodium and of absolute ether. The purified product forms a colorless crystalline powder, melting at 228°, little soluble in ether and in alcohol, easily soluble in chloroform and hot benzene. Heated with access of air, it burns, giving out flocks of silicic anhydride.

By similar processes the author obtained para-siliciumtetratolyl, $Si(C_6H_4CH_3)_4$, also melting at 228°; siliciumtetrabenzyl, $Si(CH_2C_6H_5)_4$, which melts at 127.5°. Both of these bodies form colorless crystals having properties similar to siliciumtetraphenyl. (*Ber. d. d. chem. Ges.*, XVIII, 1540.)

Silicates of the Phenols (by J. Hertkorn).—Pure crystalline phenol (boiling at 182–183°) was gently melted and treated with chloride of silicium, the former being in excess; the temperature of the mixture was gradually raised to 220° to 225°; hydrochloric-acid gas was evolved, and ceased after several hours. The simple liquid thus obtained was distilled, and the fraction, boiling at 420°, yielded, on cooling, long colorless prisms. The purified crystals, carefully dried, melted at 47° to 48°. Analysis showed the body to have the composition $(C_6H_5)_4SiO_4$, tetraphenyl silicate, and was formed as shown in the equation:

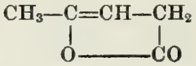
$$4C_6H_5OH + SiCl_4 = 4HCl + (C_6H_5)_4SiO_4$$

Tetraphenyl silicate dissolves easily in absolute alcohol, ether, benzene, toluene, xylene, chloroform, carbondisulphide, acetic acid, and formic acid without decomposition, but water precipitates a white gelatinous mass, and phenol dissolves out in the supernatant watery liquid. Since, however, the addition of an excess of alcohol or of ether causes the whole to go into solution, it is obvious that the precipitate consists of an acid phenyl silicate and not of silicic acid itself. With an excess of boiling water tetraphenyl silicate is completely decomposed into phenol and silicic acid.

When tetraphenylsilicate is heated with absolute alcohol, phenol and tetrethyl silicate are formed for the most part, but the latter ester yields in the presence of traces of moisture diethylsilicate, and probably hexethylsilicate.

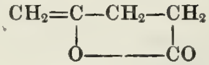
In a similar manner, the author prepared silicates of the three isomeric kresols; the *ortho* compound distilled at 435°–438°; the *meta* at 443° to 446°, and the *para* at 442° to 445°. The author likewise obtained *meta* and *ortho* tetraxylenyle silicate, $(C_8H_9)SiO_4$, as well as the silicates of six similar bodies of the aromatic series. (*Ber d. d. chem. Ges.*, XVIII, 1679.)

Some Derivatives of Lævulinic Acid (by Ludwig Wolff).—In distilling lævulinic acid a portion is decomposed and an oily substance obtained. This proves to contain two isomeric neutral bodies having the formula $C_5H_6O_2$, and behaving like lactones; one is α-angelicalactone, boiling at 167°, and the other, β-angelicalactone, boiling at 208°–209° C. The former has the constitution—



$$\begin{array}{l} CH_3-\overset{}{C}=CH-CH_2 \\ \qquad\;\;\, | \qquad\qquad | \\ \qquad\;\;\, O\text{————}CO \end{array}$$

and the latter is probably—



$$\begin{array}{l} CH_2=C-CH_2-CH_2 \\ \qquad\;\;\, | \qquad\qquad\quad | \\ \qquad\;\;\, O\text{—————}CO \end{array}$$

(*Liebig's Annalen*, CCXXIX, 249.)

Action of Phosphorus Pentachloride on Salicylic Acid (by Richard Anschütz).—By the action of one equivalent of phosphorus pentachloride on one equivalent of dry salicylic acid the author obtained a colorless highly refracting liquid, boiling at 168° under 11^{mm} mercury, which gave on analysis the composition $C_7H_4Cl_3PO_3$. This orthochlorocarbonylphenyl-orthophosphoricdichloride has the constitution—

$$C_6H_4\left\{\begin{array}{l}(1)\,COCl\\(2)\,OPOCl_2\end{array}\right.$$

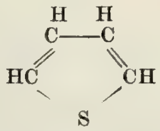
and proves to be identical with the "trichlorophosphate de salicyle," previously described by Couper. The specific gravity of this body is 1.554. Mixed with a small quantity of water this chloride dissolves with a rise of temperature, and from this solution pure salicylic acid crystallizes on cooling. Treated with a large quantity of water salicylic acid is not set free at once, but after several days ferric chloride gives a reaction. The author proposes to continue his researches. (*Liebig's Annalen*, CCXXVIII, 308.)

The Anilides of Orthophosphoric Acid (by A. Michaelis and H. von Soden).—By the action of oxychloride of phosphorus on aniline, orthophosphoric anilide, $PO(NHC_6H_5)_3$, is obtained in small crystals, soluble in boiling alcohol and melting at 208°C. On treating this with bromine it yields orthophosphorichexabromanilide, $PO(NHC_6H_3Br_2)_3$, also a crystallized body melting at 252° to 253°C.

Dianilidoorthophosphoric acid, $PO.OH(NHC_6H_5)_2$, is obtained by treating the corresponding chloride with soda lye; it forms a white powder insoluble in cold water, and decomposed by hot water into aniline and phosphoric acid. This decomposition is more quickly effected by acids. The acid melts at 196° to 197°, becoming brown. Its silver salt forms a white precipitate, soluble in nitric acid and in ammonia. (*Liebig's Annalen*, CCXXIX, 334.)

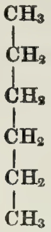
Chemical Constitution of Isatin (by H. Kolbe).—Isatin oxidized by chromic acid yields isatoic acid. This, heated with water, yields carbon dioxide and orthoamidobenzoic acid. With hydrochloric acid the chloride is formed. Sulphuric and nitric acids act similarly. Dissolved in alcohol and acted upon by hydrochloric-acid gas, ethyl orthoamidobenzoic hydrochloride is formed, which is decomposed by water. Isatoic acid with bases in the cold evolved carbon dioxide, so salts could not be formed. Ammonia solution gives ammonium carbonate and orthoamidobenzamide. Anilin acts similarly. Concentrated nitric acid gives nitroisatoic acid, which is more stable than nitric acid. This heated with hydrochloric acid or water gives a strong acid resembling metanitroorthoamidobenzoic. Reduction of the nitro-acid with tin and hydrochloric acid gives the hydrochloride of α-diamido-benzoic acid. Sulphuric acid gives the sulphate. Treatment of isatoic acid with nitrous acid gives α-nitrosalicylic acid. The author concludes that the formula $C_4H_4NCO—COH$ gives the best explanation of the above facts. (F. P. V., from *Journal f. prakt. Chem.*, XXX, 467.)

The Constitution of Thiophene (by L. Gattermann, A. Kaiser, and Victor Meyer).—In 1883 Victor Meyer proposed the following constitutional formula for thiophene:



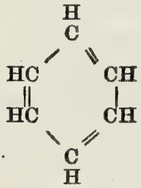
In the present article the authors refute some objections urged against this formula and present new reasons for maintaining it. (*Ber. d. chem. Ges.*, XVIII, 3005).

On the Synthetical Formation of Closed Carbon-chains. Part I—Derivatives of Trimethylene (by W. H. Perkins, jr.).—Organic chemistry is generally divided into two distinct sections, namely, the fatty series and the aromatic series. The members of the first series are derivatives of methane, the simplest hydrocarbon, and are characterized by their open or chain form, as, for example, in the case of normal hexane:



$$\begin{array}{c} CH_3 \\ | \\ CH_2 \\ | \\ CH_2 \\ | \\ CH_2 \\ | \\ CH_2 \\ | \\ CH_3 \end{array}$$

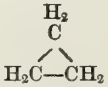
Aromatic compounds are, on the contrary, derivatives of a much more complicated basis, namely, of benzene, C_6H_6, which, as was first shown by Kekulé in 1865, has the constitution:



that is, contains a ring consisting of 6 carbon-atoms joined in such a way as to form a regular hexagon.

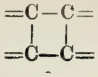
These two series differ in the most marked way from one another, the members of the aromatic series being particularly characterized by their extreme stability.

In considering the differences between these two series, the author says it is a matter of surprise that no intermediate series should be known, the members of which should possess partly the character of fatty and partly that of aromatic compounds. It is quite reasonable to suppose that rings should exist having 3, 4, 5, 7 carbon-atoms as well as 6 carbon-atoms, though the few experiments made to test this supposition have up to this time failed to throw much light upon the subject. Victor Meyer has discussed the improbability of the existence of a 3-carbon-atom ring:

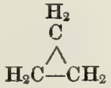
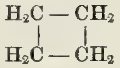
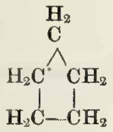
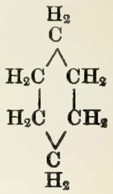


which would be isomeric with propylene, $CH_3.CH.CH_2$; but Reboul, by acting on trimethylene bromide with sodium, obtained a gas which he supposed to be ordinary propylene, and Freund has indicated certain reactions of this gas which the author (Perkins) shows are evidences of its being true trimethylene.

No attempts appear to have been made to synthesize the analogous 4-carbon ring:

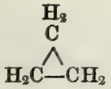
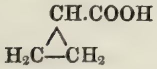
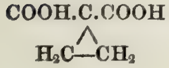
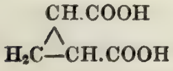


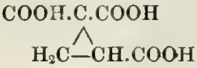
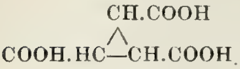
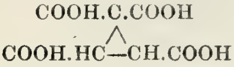
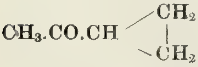
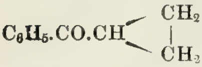
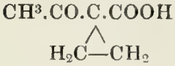
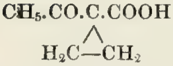
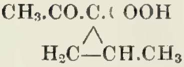
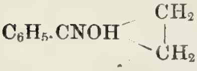
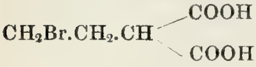
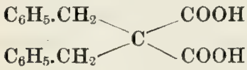
though acenaphthene, a body in the aromatic series, without doubt contains such a ring. Fluorene is a hydrocarbon containing a 5-carbon ring, and several known bodies of the fatty series are closely allied to the hypothetical 4 and 5 carbon rings. These are furfuran, pyrrholine, succinimide, and parabanic acid. The author adopts the following scheme of nomenclature for the 3, 4, 5, and 6 carbon rings:

Methylene.	Di-methylene (Ethylene).	Tri-methylene.	Tetra-methylene.	Penta-methylene.	Hexa-methylene.
$=CH_2$	$CH_2=CH_2$				

He also proposes to distinguish the possible isomers by numbering the carbon-atoms in the ring as suggested by Baeyer (*Ber. d. chem. Ges.*, XVII, 960). The author describes fully the methods of preparation and the properties of a number of trimethylene derivatives, and promises at an early date to do the same for some tetramethylene derivatives.

The following table contains a list of the trimethylene bodies with their chief characters:

Formula.	Name.	Melting point.	Boiling point (720mm).
	Trimethylene	Gas	....
	Trimethylenecarboxylic acid ..	18–19°	182–184°
	Trimethylenedicarboxylic acid (1 : 1).	140–141°	....
	Trimethylenedicarboxylic acid (1 : 2).	137°	....

Formula.	Name.	Melting point.	Boiling point (720mm).
	Trimethylenetricarboxylic acid (1 : 1 : 2).	184°	....
	Trimethylenetricarboxylic acid (1 : 2 : 3).	145–150°	....
	Trimethylenetetracarboxylic acid (1 : 1 : 2 : 3).	95–100°	....
	Acetyltrimethylene	Liquid ..	112–113°
	Benzoyltrimethylene	Liquid ..	239–239.5°
	Acetyltrimethylenecarboxylic acid.	Liquid ..	....
	Benzoyltrimethylenecarboxylic acid (1 : 1).	148–149°	....
	Acetylmethyltrimethylenecarboxylic acid (1 : 2 : 1).	Liquid ..	....
	Benzoyltrimethyleneoxime	86–87°	....
 $CH_2Br.CH_2.CH{<}^{COOH}_{COOH}$	γ-Bromethylmalonic acid	116–117°	....
$C_6H_5.CO.CH_2.CH_2.CH_2.Br.$	ω-Bromopropyl phenyl ketone.	37–39°	....
 $^{C_6H_5.CH_2}_{C_6H_5.CH_2}{>}C{<}^{COOH}_{COOH}$	Dibenzylmalonic acid	170–172°	....

Ethereal salts of many of these bodies were also prepared and studied.

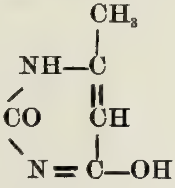
By heating hydroxylamine and hydrochloric acid with benzoyltrimethylene, in a sealed tube, a complicated reaction sets in, yielding a deep-blue solution with an intense brick-red fluorescence. This solution proved to contain two distinct bases; that soluble in ether was found to have the constitution $C_{30}H_{28}N_2O_2$. It is easily soluble in acetone, aniline, and nitrobenzene, more sparingly in alcohol, ether, and in benzene. If the brownish-red alcoholic solution be treated with zinc dust and ammonia, it is reduced and becomes colorless; on agitating with air it is reoxidized. The salts of this base are easily obtained, and form deep-blue solutions with a most magnificent brick-red fluorescence. The hydrochloride in a solid state outwardly resembles indigo in every respect, and its solution shows the same absorption spectrum as indigo. The internal constitution of this complicated molecule has not been ascertained.

The salts of trimethylenedicarboxylic acid (1 : 1) with ammonium, silver, copper, barium, and lead, form well-defined crystallized bodies. (*J. Chem. Soc. London*, 1885, 80.)

Syntheses of Derivatives of Urea (by Robert Behrend).—By the action of one molecule of acetic ether on one molecule of urea in alcoholic solution, the author obtained β-uramidocrotonic ether in accordance with the equation:

$$C_6H_{10}O_3 + CON_2H_4 = C_7H_{12}O_3N_2 + H_2O.$$

This body forms silky needles, melting at 165° to 166° C, insoluble in water, and crystallizing easily from alcohol. With alcoholic soda solution the salt $C_5H_7N_2O_3Na$ forms with separation of alcohol. This sodium salt, treated with acids (even carbonic acid is active), yields the body $C_5H_6N_2O_2$, for which the author proposes the name methyluracil, a name, however, not intended to indicate constitution. Methyluracil crystallizes from hot water in colorless needles; it is soluble in alcohol and insoluble in ether. It is decomposed on heating to 270°—280°, becoming blackened and not melting. It dissolves easily in soda and potassa solutions, forming salts identical with those of uramidocrotonic ether. Theoretical considerations, which we cannot here detail, lead the author to adopt provisionally the following constitutional formula for methyluracil:



Bromine acts on methyluracil in the cold and yields brommethyluracil $C_5H_5BrN_2O_2$, a body crystallizing in microscopic prisms. Bromine converts this into a di-brom-compound. Strong nitric acid converts methyluracil into a nitro-compound, $C_5H_3N_3O_6$, which, by loss of carbonic acid, yields $C_4H_3N_3O_4$ nitro uracil. The latter is reduced by tin and hydrochloric acid to, $C_4H_5N_3O_2$, amido-uracil; and this in turn by oxidation yields oxy-uracil, $C_4H_4N_2O_3$, an isomer of barbituric acid. Amido-uracil unites with cyanic acid, forming hydroxyxanthin, on which body the author continues his researches. (*Liebig's Annalen*, CCXXIX, 1.)

Synthesis of Cocaïne, the New Anæsthetic (by W. Merck).—At the chemical manufactory of E. Merck, in Darmstadt, a quantity of a lye product was obtained in the extraction of cocaïne, which was sent for examination to W. Merck, in Kiel. It formed a colorless, crystallizable body, having a slight acid reaction, melting at 188·5° to 189°, and yielding by decomposition benzoic acid and ecgonine. Merck recognized it as benzoyl-ecgonin, or ecognine in which one hydrogen atom is replaced by benzoyl, $C_9H_{14}NO_3—C_7H_5O$. By heating this substance with potassium hydroxide and methyliodide cocaïne was obtained:

$$\overset{\text{Benzoyl-ecgonine.}}{C_{16}H_{19}NO_4}+CH_3I+KOH=\overset{\text{Cocaine.}}{C_{17}H_{21}NO_4}+H_2O+KI.$$

The artificial product was found to have all the properties of the natural.

Almost simultaneously with this result of Merck, the synthesis was accomplished by Scraup, who employed a mixture of benzoyl-ecgonine, sodiummethylate, and methyliodide. Scraup's method yielded, however, only about 4 per cent. of the theoretical amount, while Merck obtained 80 per cent. of the theoretical yield. Subsequently Merck succeeded in transforming ecgonine itself directly into cocaïne by heating a mixture of methyliodide, benzoic anhydride, and anhydrous ecgonine:

$$2C_9H_{15}NO_3+(C_7H_5O)_2O+2CH_3I=C_{17}H_{21}NO_4HI+C_9H_{15}NO_3HI+C_7H_5O_2CH_3.$$

By introducing the radical ethyl a homologue of cocaïne was obtained which the author calls cocäthyline. Merck is continuing his researches. (*Berichte d. chem. Ges.*, XVIII, 1594, 2264, and 2952.)

The Fat or Wax obtained from Cinchona—Researches on Bark.—O. Hesse obtains from the Cuprea barks cupreol, a compound which in all points resembles quebrachol. This body crystallizes from alcohol in colorless satiny leaflets, which quickly become dull in dry air. It is readily soluble in chloroform, ether, and hot alcohol; less readily in petroleum ether, and cold alcohol, and in water, ammonia, and potash-lye not at all. It melts at 140°, and at higher temperatures it volatilizes, unchanged in a current of hydrogen or carbonic acid. The solution in chloroform, when shaken with sulphuric acid of 1·76 spirit grains, turns a blood red, as do the the chloroform solutions of quebrachol, cholesterin, or phytosterin. Cinchol occurs in all true cinchona barks, but not in cuprea bark. From alcohol it crystallizes partly in long, almost acicular leaflets, partly in broad leaves, and always with 1 molecule of water. It loses a part of its water at 20° to 25°, and the rest at 100°, or in the desiccator. Anhydrous cinchol melts at 139° and in other respects has the properties of cupreol. The author describes the acetyl and propionyl derivations of cupreol. The china bark contains, therefore, three isomeric bodies, having the formula $C_{20}H_{34}O$, cupreol, cinchol, and quebrachol; all three belong to the cholesterins. (*Liebig's Annalen*, CCXXVIII, 288.)

Relation between Antiseptic Power and Chemical Constitution (by Dr. J. R. Duggan.)—The author has made some suggestive experiments on this relation to pave the way for further investigations. The following table is a list of the substances whose restraining influence has been determined with approximate accuracy, and of the amounts required in parts per 10,000 of the solution:

Oxybenzoic acids, $C_6H_4(COOH)(OH)$.

	Parts in 10,000.
Salicylic acid (1:2)	4
Oxybenzoic acid (1:3)	6
Paraoxybenzoic acid (1:4)	8

Phenols, $C_6H_5(OH)_x$.

Phenol, $C_6H_5(OH)$	20
Pyrocatechin $C_6H_4(OH)_2$ (1:2)	20
Resorcin $C_6H_4(OH)_2$ (1:3)	25
Hydroquinone $C_6H_4(OH)_2$ (1:4)	30
Pyrogallol $C_6H_3(OH)_3$	15

Alcohols, $RCH_2(OH)$.

Methyl alcohol $CH_3(OH)$	300
Ethyl alcohol $C_2H_5(OH)$	500
Propyl alcohol $C_3H_7(OH)$ normal	200

The germicide power of formic, acetic, and propionic acids was also tested and found to be nearly in an inverse ratio to their acidity. For the peculiar order of the alcohols given in the above table the author can suggest no explanation. (*Am. Chem. Journ.*, VII, 62.)

Occurrence of Citric Acid in Seeds of Leguminous Plants (by H. Ritthausen).—The existence of citric acid, together with malic and oxalic acids, in the seed of the yellow lupine (*Lup. luteus*) has already been shown. The author finds it also in the seed of *Vicia sativa* (vetch), *V. faba* (hog's bean), various varieties of peas, and in the white garden bean (*Phaseolus*). The powdered seeds are digested with water acidified with hydrochloric acid, the solution filtered, neutralized with an alkaline hydrate. and precipitated with lead acetate. This is suspended in water, treated with sulphuretted hydrogen, and the citric acid gotten in the usual way from the acid liquid. The white bean contains very little citric acid, and peas contain less than the other legumes mentioned. (*Jour. f. prakt. Chem.*, XXIX, 357.)

Percentages of Alcohol in Ciders and of Acetic Acid in Vinegars (by W. French Smith).—This investigation was made to determine the maximum and minimum percentages of alcohol and acetic acid which genuine apple juice would produce.. The expressed juice of selected apples was allowed to ferment slowly for two months in a cellar at an average temperature of 14° C. The determinations of alcohol were then made by the ordinary method of distillation and specific gravity. Selected "August Sweets" gave 9·40 per cent. alcohol; the same variety of average quality gave 6·05 per cent.; and imperfectly ripe apples of same variety gave 4·80 per cent. "Greening" apples picked from the trees gave 4 per cent. alcohol. The average of eight experiments gave 5 per cent. *by weight.* Ten months later the acidity and solid residue in the samples was determined; the former varied between 10·1 per cent. and 4·40 per cent., and the latter between 2·70 per cent. and 3·64. The actual amounts of acetic acid found are lower than the alcoholic percentages in the original ciders demand, owing to imperfect acetification.

This investigation shows that a good cider should contain about 5 per cent. alcohol, and a fair sample ought not to fall below 4 per cent.; a good cider vinegar ought to contain from 5·5 of acetic acid to 7 per cent. (*Journ. Am. Chem. Soc.*, VII, No. 4.)

NOTES.

During the year 1884, 281,000 pounds of bromine were produced in the United States, 7,000,000 pounds of borax, and 1,800 troy ounces of of aluminium. (ALBERT WILLIAMS, Jr. *Report on Mineral Resources of the United States.*)

During the year 1883 there were manufactured in Germany 148,450 tons of hydrochloric acid and 115,500 tons of carbonate of soda; half of the latter was made by Solvay's process. During the same year there were manufactured in England 940,638 tons of sulphuric acid (calculated as H_2SO_4); 429,040 tons of soda ash (calculated as Na_2CO_3); and 141,868 tons of bleaching powder. Dr. Lunge thinks the Leblanc process and ammonia process for manufacturing soda will flourish side by side, and the latter will not displace the former unless hydrochloric acid can be made at the same time. (*Chemische Industrie*, VII, 78 and 213.)

Professor Mart. Websky has continued his researches on the supposed new element, idunium, contained in the lead vanadate of Cordoba (Argentine Republic), but has been unable to establish the identity of the metal as a new species. (*Sitzungsb K. Akad., Wiss. Berlin, February* 5, 1885, *page* 95.)

The rare metal gallium has been prepared by Dr. L. Ehrlich by an industrial process. From 80 kilos of zinc blende he obtained 0·9 grams gallium. The melting point of the metal is 30·5° C. The luster of gallium globules is greater than that of mercury. (*Chemiker-Zeitung.*)

Greville Williams finds that zinc dust occludes hydrogen. A given sample of commercial zinc dust contained 39 times its volume of hydrogen. The experimenter thinks the absorbed gas was originally derived from water and shows the bearing of this on the conclusions arrived at in the case of the Lenarto meteorite. (*Journal of Gas-Lighting.*)

The decomposition of potassium chlorate by heat has been studied anew by Dr. F. L. Teed. He finds that the equation commonly employed [$2KClO_3 = KClO_4 + KCl + O_2$] does not truly represent the facts, and proposes the following: $10KClO_3 = 6KClO_4 + 4KCl + 3O_2$. The author confirms the statement that when MnO_2 is heated with the $KClO_3$ no perchlorate is formed. The phenomena noted appear to indicate that the molecular weight of the salt is much higher than is required by the formula $KClO_3$. (*J. Chem. Soc. Lond.*)

New reasons for considering liquid or solid sulphur trioxide as S_2O_6 rather than SO_3 are afforded by the results of experiments reported by Dr. E. Divers and T. Shimidzu upon the reactions of pyrosulphuric acid with silver, mercury, and copper. When freed carefully from moisture, sulphur trioxide is without action on these metals, unless a little sulphuric acid be present. The reaction with silver is as follows:

$$(SO_2)SO_4 + 2Ag = Ag_2SO_4 + SO_2.$$

(*Chem. News.*)

By heating in sealed tubes glucose with strong ammonia and subsequent treatment with solvents C. Tauret obtained two new alkaloids, which he calls, respectively, α-glucosine and β-glucosine. These form volatile colorless liquids, with a peculiar strong odor, the first boiling at 136° and the second at 160°. In acid solution they are precipitated by the usual reagents for alkaloids; with hydrochloric acid they form hydrochlorates. (*Bull. soc. chim.*, XLIV, 102.)

Professor Carnelley and James Schlerschmann have investigated the influence of strain on chemical action. Working with copper wires free and under strain, exposed to the action of ammonium chloride, they come to the conclusion that strain exerts no perceptible influence upon chemical action under the conditions described. (*Chem. News*, LII, 6.)

The causes of the decrepitations in samples of so-called explosive pyrites have been studied by B. Blount and formulated as follows: (1) The decrepitations are due to the presence of CO_2, together with more or less H_2O. (2) The CO_2 is confined at high pressures probably sufficient to liquefy it. (3) The usual temperature at which the pyrites begins to decrepitate is 30° to 36° C. (*Chem. News*, LII, 7.)

The removal of micro-organisms from water forms the subject of a valuable paper by Dr. Percy F. Frankland, in the *Chemical News*, LII, 27, *et seq.*

Chlorochromic acid is prepared, according to H. Moissan, by bringing together gaseous hydrochloric acid and pure chromic anhydride perfectly free from sulphuric acid. On warming red fumes appear, which condense into chlorochromic acid; but a portion is decomposed by the water formed at the same time. Dry chlorine does not attack chromic anhydride. Gaseous hydrobromic and hydriodic acid do not form analogous chromium compounds. (*Bull. de l'Assoc. des Élèves de M. Frémy*, 2.)

Cocaine, the established anæsthetic, according to G. Calmels and E. Gossin, is "methylicbenzometholethyltetrahydropyridine carbonate." (*Comptes rendus*, C, No. 17.) See Professor Odling's Plea for Empiric Names, in this report, under the head "Organic."

Researches on the influence of silicon upon the properties of cast iron, by Thomas Turner, show that, contrary to the generally accepted views on this subject, a suitable addition of silicon to cast iron improves the tensile strength of the metal. An addition, however, of more than 2.5 per cent. causes deterioration. (*Chem. News*, LII, 5.)

Eleven months' experience with toughened glass beakers made under De La Bastie's patents leads R. J. Friswell to the conclusion that "toughened glass is a complete failure in the laboratory." (*Chem. News*, LII, 5.)

The adulteration of beer is discussed in a paper by Prof. H. B. Cornwall presented to the American Public Health Association. The average contents in alcohol of twelve beers was 4.197 per cent., and of extract, 6·26 per cent. Milwaukee beer contains as high as 5·35 per cent. of alcohol.

The apparatus and process for liquefying oxygen gas, employed by Cailletet, are figured and described in the *Journal de physique*, and in *Nature* (XXXII, 584), to which we refer for details.

Chlorine monoxide has been studied anew by K. Garzarolli-Thurnlackh and G. Schacherl. It forms a dark brown liquid, having a yellowish-brown vapor; its density is 3·0072 at 10·6° C. and 726·4^{mm}, and its boiling point is 5° C. at 737·9^{mm}. Exposed to sunlight it does not decompose as commonly stated, and if organic material be excluded it does not explode in passing from the liquid to the gaseous state. (*Liebig's Annalen*, CCXXX, 273.)

By distilling plants in a fresh state with water, M. Maquenne has obtained small quantities of methylic alcohol, but he has not ascertained whether this body exists ready formed in the plants or is produced during the distillation. (*Comptes rendus*, CI, 1067.)

Vacciniin, a bitter principle occurring in the cowberry, discovered by Edo Claassen in 1870, has been found by the same chemist to be identical with arbutin, extracted from *Arbutus uva ursi*, Lin.—(*Am. J. Pharm.*, 1885.)

Under the title "The Sugar Chemistry of the United States" Prof. Harvey W. Wiley, chief chemist to the Department of Agriculture, has issued a valuable compend, in four parts, relating respectively to cane, beet, sorghum, and maple sugars. The analyses of maple sugar are numerous, and we learn that "there is no method of detecting the adulteration of maple sugar with other sucroses. The temptation to this adulteration is great because maple sugar commands nearly double the price of other sugars. Neither chemistry nor optics will help to a decision as to adulteration." A patented extract of hickory bark is used to give the characteristic flavor of maple sugar to glucose or cane sirups.

The second annual meeting of the Association of Official Agricultural Chemists was held September 1 and 2 at Washington, D. C. In the absence of Professor Johnson the chair was taken by the vice-president, Prof. H. C. White. The "Proceedings," published by the Department of Agriculture as *Bulletin* No. 7, of the Division of Chemistry, will be found invaluable to all analytical chemists.

The chemical section of the American Association for the Advancement of Science met in August at Ann Arbor. The chairman of the section, Prof. William Ripley Nichols, addressed the members on "Chemistry in the Service of Public Health." The address will be found in the "Proceedings" of the association, vol. XXXIV.

The Institute of Chemistry (England) has undergone a transformation. Originally founded in October, 1877, with a membership of 150, it grew to embrace over 400 fellows. On the 30th of June, 1885, it ceased to have an official existence, but meanwhile, on the 13th of June, 1885, another organization was perfected under the title "Institute of Chemistry of Great Britain and Ireland," and the officers of the original society became officers of the new one. The new institute has secured a royal charter and has public duties and privileges accorded it, becoming a professional body officially known to Government. Dr. Odling, the president, gave his address November 6, 1885. (See *Chemical News*, LII, 243.) Dr. Odling's address is severely criticised by an anonymous writer in *Nature* (XXXIII, 73), who protests strongly against the commercial aspect of the views enunciated. He says: "The spirit [of the address] is an alien spirit, repugnant to students of pure science in this country."

A biography of the late Dr. Robert Angus Smith was read at the annual general meeting of the Manchester Literary and Philosophical Society held April 21, by Dr. E. Schunck. It will be found in *Chem. News*, LI, 293.

Prof. Edward Divers, of the Imperial College of Engineering, Tokio, met with a serious accident which threatened the loss of an eye. In attempting to remove the stopper of a bottle containing phosphorus trichloride he gently warmed the neck, when the bottle exploded violently, and projected glass into one eye. Dr. Divers supposes moisture had entered the bottle and formed hydrochloric acid, thus producing gas under tension.

On Monday, August 1, 1885, Prof. Michel Eugene Chevreul entered upon his one hundredth year. Apart from the fact that among men whose lives have been devoted to active scientific research no one has before attained so great an age, Chevreul stands conspicuous for the vast amount of work he has done, and for the great practical effect his work has had on the industries of the world. His researches on "les corps gras," begun in 1813, continued until 1823, when they appeared in a volume dedicated to Vauquelin, his teacher. His researches on color occupy the whole of volume XXXIII of the *Mémoirs* of the Institut. It has often been remarked, it is difficult to realize that the Chevreul of "corps gras" fame and the Chevreul who wrote on colors are one and the same man. (Condensed from *Nature*, XXXII, 425.)

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Wurtz, A.—Introduction à l'étude de la chimie. Paris, 1885. 8vo.

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Zängerle, M.—Kemian alkeet. Porvoosa, 1885.

NECROLOGY OF CHEMISTS: 1885.

Thomas Andrews, born December 19, 1813, at Belfast; died November, 1885. He held the vice-presidency of Queen's College in Belfast, and was professor of chemistry in the same institution. His original researches, chiefly in physical chemistry, were numerous and valuable.

Edw. H. von Baumhauer, died January 18, 1885, at Leyden. He was born September 18, 1820, and for many years was professor of chemistry and pharmacy at Amsterdam. He held also the office of perpetual secretary of the Netherland Society of Sciences at Harlem.

E. O. Brown, died December 5, 1885. He was one of the chemists in the Royal Arsenal, Woolwich, under Sir F. Abel. His knowledge of the chemistry of explosives is said to have been unsurpassed.

Arthur Calm, died in January, 1885. He was instructor in chemistry at the University of Zürich.

John Christopher Draper, born March 31, 1835; died December 20, 1885. He held chairs of chemistry and of natural history in New York colleges, and published several text-books on physiology and chemistry. His original researches were chiefly in the domain of medical chemistry.

Hermann von Fehling, vice-president of the German Chemical Society, died July 1, 1885. He was born June 9, 1812, in Lübeck. In both research and literary work Fehling has left an enviable record.

Frederic Field, one of the original members of the London Chemical Society, died April 3, 1885. He was authority on South American mineralogy, mining, and metallurgy, having resided in Chili for many years. His memoirs on different branches of chemistry are fifty-five in number.

Albert Fitz, of Strassburg, died May 11, 1885. He was one of the pioneers in investigating the changes in organic bodies effected by microscopic plants.

Walter Flight, born January 21, 1841; died November 4, 1885. Dr. Flight was for many years assistant in the mineralogical department of the British Museum. He published many valuable papers on the chemical composition of meteorites, and of the occluded gases contained in them. For a fuller biography, see *Nature*, XXXIII, 85.

Philipp Greiff, member of the German Chemical Society, died September 17, 1885.

Otto Mendius, of Ziegelhausen, died March 21, 1885. He was the author of the well-known "Mendius' Reaction," for converting nitrites into primary amines.

Hermann Römer, born October 31, 1848, at Mahlen, in Silesia; died in Berlin, January 27, 1885. He was instructor in the Technical School at Berlin.

Benjamin Silliman, born December 4, 1816; died January 14, 1885. He was one of the founders of the Sheffield Scientific School, and professor of chemistry in the Yale Medical School. For a full biography, see *American Journal of Science.*

Alfred Tribe, died November 26 at the age of forty-six. His researches in conjunction with Dr. Gladstone have been numerous and important.

Walter Weldon, born October 31, 1832; died September 21, 1885, at his residence in Surrey. He was a most successful technical chemist, the author of the well-known "Weldon process" for regenerating the MnO_2 used in the preparation of chlorine. For fuller notice, see *Chem. News*, LII, 176.

George Witz, of Rouen, died June 17, 1885, aged 48 years. He made important contributions to the chemistry of cellulose.

Gustav Wunder, director of the *Technische Staats-Lehranstalten* in Chemnitz, died September 20, 1885. He was a member of the German Chemical Society.

MINERALOGY.

By Prof. **Edward S. Dana**,
Yale College, New Haven, Conn.

GENERAL WORKS ON MINERALOGY.

The list of mineralogical works published in 1885 includes a new edition of Naumann's *Elemente der Mineralogie.*[*] This is the twelfth edition of the work, and, like the tenth, issued in 1877, and the eleventh, in 1881, has been edited by Professor Zirkel, of Leipzig. It includes the numerous additions of the past four years, and since then the whole matter has been thoroughly worked over. While not aiming at exhaustive completeness, it yet gives much more than any other treatise in the German language, and is a decided advance upon previous editions of the work. The *Lehrbuch der Mineralogie* of Tschermak, the first edition of which was noticed in the report for 1883, has appeared in a second edition, with some minor additions and corrections. Increased acquaintance with the work brings a higher appreciation of its excellence, more especially as regards its treatment of subjects in physical mineralogy. The veteran Russian mineralogist, N. v. Kokscharow, continues his labors with unremitting activity. The product of the past year is an additional portion of the ninth volume of the *Materialien zur Mineralogie Russlands*, covering pages 81 to 272, and giving a general description of the species turquois, and supplementary chapters on topaz, vesuvianite, nephelite, orthoclase (sanidine) and linarite.

A new edition of Groth's *Physikalische Krystallographie* has been published, with a very large amount of new matter, increasing the size of the volume nearly one-half. The additions are largely in the chapters devoted to the methods and instruments employed in the study of the physical characters of minerals, which are treated with a fullness that leaves nothing to be desired. The work is comprehensive throughout and only to be compared with Mallard's *Traité de Cristallographie*, noticed in the report for 1884, which, however, occupies a somewhat different field. Rosenbusch has completed a new edition of his invaluable *Mikroskopische Physiographie der petrographisch wichtigen Mineralien*, largely increased in size and improved in every way. The work is unrivalled in its special sphere, and is essential not only to the petrographer but also to the general mineralogist, being the production of an author who is thoroughly informed of the work done by others, and at the same time has himself made extensive contributions in the same direction. Under the title of *The Determination of Rock-forming Minerals*, has been issued a translation, by E. G. Smith, of Beloit College, of Hussak's work (report for 1884), which is thus placed in convenient form for English-reading students. *Hirschwald's* catalogue of the mineral collection of the Berlin University is an addition to topographical mineralogy. Hatle has prepared a summary of the mineral occurrences of Styria. In the department of meteorites the catalogue of the nearly unrivalled collection in Vienna by Brezina is interesting not only as a catalogue, but for the discussion of the classification of meteorites and of various points in regard to their structure and origin.

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[*] For full titles of works mentioned, see the Bibliography at the close of the chapter.

A second report on the *Mineral Resources of the United States* for the calendar years 1883, 1884, has been issued by the U. S. Geological Survey, under the same editorship as the first volume—Albert Williams, jr. This volume is much larger than its predecessor and is made up almost entirely of new matter. After a general summary by the editor, a series of chapters, prepared for the most part by different specialists, are devoted to each subject, many of them treated with great fullness. Thus, to the subject of coal and coke two hundred pages are given; chapters on petroleum and natural gas follow; then extended papers on iron, gold and silver, copper, lead, zinc, mercury, and the other metals, these last covering pages 246 to 661., The remainder of the volume is given to a variety of subjects, as building materials, abrasive materials, precious stones, fertilizers, mineral paints, glass materials; also salt, graphite, pyrites, and so on. The whole volume contains a vast amount of material of value and interest to a great variety of readers in practical life.

A fifth Annual Report of the Mineralogy of California has been issued by the State mineralogist, H. G. Hanks. It is largely devoted to an account of the exhibit of California and other States at the recent Exposition in New Orleans. The bulletins of the U. S. Geological Survey recently issued are some of them devoted to mineralogical subjects, more particularly No. 20, containing contributions to the mineralogy of the Rocky Mountains, by W. Cross and W. F. Hillebrand. This is largely a reprint of papers (on zeolites, cryolite, &c.) previously published, but contains also some additions and emendations of the original matter. Another bulletin contains a description of the secondary enlargement of mineral fragments (amphibole, quartz, &c.) in certain rocks, by R. D. Irving and C. R. Vanhise.

CRYSTALLOGRAPHY AND PHYSICAL MINERALOGY.

A crystallographic memoir of more than usual comprehensiveness is that of Ernst Rethwisch* on the ruby silvers (Rothgültigerz); it is in fact exhaustive in its treatment of the subject, though not original in matter for the most part. It opens with a catalogue of papers and books treating of the species pyrargyrite and proustite—extending from 1657 to the present time—and then goes on to give a statement of the results reached, chemical and crystallographic. The list of planes observed on the two species is one hundred and eight, with three doubtful ones. To this long list the author considerately makes no new additions. He discusses critically, however, the results of earlier observers, as Haüy, Mohs, Lévy, and Sella—of whom, for example, Sella added forty-nine new forms—and for convenience of reference gives a series of lists arranged according to zones, according to the numerical value of the indices, by combinations, and so on. He details also a series of measurements made upon four varieties, all of which were analyzed, and which included a pure proustite (containing no antimony), a pure pyrargyrite (with no arsenic), and also two varieties of the latter mineral, with 2·62 and 3·01 per cent. arsenic, respectively. It appears from these that the fundamental rhombohedron becomes a little more acute as the amount of arsenic increases. The values of the vertical axis in the different cases are 0·8034 (proustite), 0·7890, 0·7893, 0·7865 (pure pyrargyrite). A long list of calculated angles completes the memoir. The first part of a somewhat similar monograph has been issued by Sansoni, of Pavia. This is devoted to the calcite of Andreasberg, but when completed the memoir is to cover the whole species. The author has attacked the subject with great vigor, notwithstanding its difficulty and the large amount of the literature devoted to it. His observations are largely original, based upon a collection of twenty-five hundred specimens, loaned from many museums. The number of crystals measured is stated to be seven hundred and twenty-two. Eight types of forms are described and illustrated by a series of figures. The number of planes included is one hundred and thirty-one, occurring in three hundred and fifty-nine combinations.

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* For references, see the list of papers on mineral species at the close of this chapter.

An interesting contribution to the morphology of the species rhodonite has been made by G. Flink. The specimens examined were from Pajsberg and Långban, in Sweden, and included a large number of crystals showing considerable variety in habit and occurring planes. The number of the latter identified is twenty-nine, of which nineteen are new. The author follows the suggestion first made in Dana's System of Mineralogy, and later developed by Groth, and adopts the position which brings the crystals into correspondence with the related monoclinic pyroxene. This relation he discusses at length, and shows that the similarity in forms and angles and cleavage between the triclinic rhodonite and monoclinic pyroxene is very close, to be compared with that between the monoclinic and triclinic feldspars. The axial relations are:

	a : b : c	α	β	γ
Rhodonite	1·0727 : 1 : 0·62104	76° 42′	71° 16′	81° 39′
Pyroxene	1·0903 : 1 : 0·5893	90	74 11	90

The author also discusses at length the optical constants of the species. Two plates of figures show the various habits of the crystals. Some of the tabular forms are strikingly like the crystals recently obtained in some abundance at Franklin Furnace, New Jersey (variety fowlerite).

Penfield has described crystals of tiemannite from Utah and also crystals of metacinnabarite from California. The former mineral, the pure selenide of mercury, has hitherto been known only in massive form. It is now shown to crystallize in tetrahedral crystals, similar to sphalerite in habit and in twinning. Metacinnabarite, the black amorphous sulphide of mercury described by G. E. Moore, is also shown to crystallize in similar tetrahedral forms, the crystals, however, being less distinct and perfect than those of tiemannite. These two species thus take their proper places in mineralogical classification. It does not appear, however, that the dimorphous forms of the sulphides of zinc and mercury, wurtzite and cinnabar, bear any close relation to each other. Penfield's determinations give the crystallized tiemannite a specific gravity of 8·19, much higher than that before accepted for the species; also that of metacinnabarite 7·81, while the intermediate compound onofrite—the sulpho-selenide of mercury—from Utah lies between them with a specific gravity of 8·04.

Crystals of azurite from the Clifton mines in Arizona have been measured by O. W. Huntington. They are shown to be highly modified, though not adding to the already large list of the species (this list includes fifty-one or fifty-two planes). The measured angles also correspond closely to those of the Chessy crystals. The work on the descloizite crystals of New Mexico by vom Rath, according to whom they are to be taken as orthorhombic, is referred to on a later page.

The apparent cleavage of titanite parallel to the hemipyramid η (2 P of the usually accepted form), conspicuous on the crystals from Northern New York, has been shown by G. H. Williams to be only a structural "parting," due to the interposition of twin lamellæ. It thus has the same explanation as the frequently observed "cleavage," parallel to the basal plane of pyroxene, and similarly in other cases. The same author has described crystals of amphibole from Saint Lawrence County, New York, which were interesting in showing several new planes in the prismatic zone. Penfield has figured and examined optically some curious composite crystals of analcite from the Lake Superior copper region, remarkable for their symmetrical arrangement. The quartz crystals of North Carolina, hardly second to those of the Alps in interest and complexity of crystalline form, have received the attention they deserve at the hands of vom Rath. His memoir upon them is accompanied by numerous figures showing the various types of forms.

Additional observations on the crystalline form of the beautiful new borate, colemanite (see the report for 1884), have been published by Jackson, Hiortdahl and Arzruni. Palla has studied crystals of göthite from Cornwall, and attempted to show that the measurements can be explained only by the assumption of the presence of "vicinal" planes with very complex indices, or else of a monoclinic form with an obliquity of 36′. The correctness of such conclusions may fairly be questioned. The phlogopite of Templeton, Canada, which is black to brown in color and shows the well known asterism, has been studied by Lacroix. His results go to prove that the inclusions to which the asterism has been long recognized as due are in this case minute acicular crystals of rutile, which cross each other at angles of 90°, 120°, and 150°. Doelter has added to our knowledge of the relation between the optical properties and chemical composition of the various kinds of pyroxene, a subject the interest of which has already been recognized.

The optical behavior and micro-structure of corundum forms the subject of an interesting paper by Lasaulx, which goes far to settle the disputed question as to its true crystalline form. He concludes that corundum is truly optically uniaxial and hence is to be referred to the rhombohedral, not the monoclinic, system, and that the anomalous optical characters which have suggested the latter conclusion are connected with disturbances due to the growth and structure of the crystals. The optical irregularities are further associated with structure planes parallel to the rhombohedron, the base and the second hexagonal prism; the lamellar structure in these directions conditions the cleavage or "parting" often observed parallel to one or more of these forms. This parting, he concludes, is not caused by twinning lamellæ, as has been assumed, but the latter determined by the presence of the structure planes, both appearing simultaneously. The optical irregularities are caused in part by tension in certain of the crystal, in part as a consequence of the interposed twin-lamellæ.

Rinne has made a study of the rare silicate milarite from an optical point of view, and reached the conclusion that it is to be taken as belonging in fact to the hexagonal system, although secondary causes have given it the optical structure which has led to its being classed as an orthorhombic species with hexagonal pseudo-symmetry. An analogous conclusion is reached by the same author in regard to apophyllite. Stadtländer has contributed the results of an optical study of sections of apophyllite crystals from Stempel, near Marburg, extending our knowledge of the optical anomalies and showing that, as has been proved before, they must be referred to secondary causes.

The often-discussed subject of the true form of leucite crystals (see report for 1884) has received an interesting contribution from Rosenbusch. After reviewing the results reached by others, especially by Klein, he goes on to detail the results of some experiments by himself on the effect of a high temperature upon the twin structure of the crystals. A section of an implanted crystal of leucite from Vesuvius, showing distinct twinning lamellæ, was held in the platinum-pointed pincers before a microscope in such a position that a strong reflected light brought out clearly the twinning lamellæ as contrasted with the rest of the surface, and then strongly heated. Various sections were taken, but in every case when the heating commenced the surface under examination showed a peculiar movement, leading as the temperature rose to a change in the number, position, and dimensions of the twinning lamellæ. Finally, when the heat was sufficiently increased all these lamellæ and all breaks in the surface disappeared, and the entire surface reflected the light evenly. With a fall of the temperature, however, the irregularities in structure re-appeared, but not so as to reproduce exactly the original section; that is, the position and number of the twinning lamellæ were changed, although the law of twinning remained constant. The significance of such experiments, especially in connection with the disappearance of the optical anomalies with a high temperature, is obvious.

Brauns has followed up a line of investigation earlier undertaken by him (report for 1883) in regard to the double refraction in crystals, which are isomorphous mixtures of salts normally isometric and isotropic, and has developed some interesting facts of this kind. He recognizes the double refraction in such mixtures (as of different alums) as secondary, but regards the final cause as yet undetermined, only suggesting that the different volumes of the molecules and different powers of refraction may play an important part in the matter. The minerals of the spinel or magnetite group have been made the object of a series of etching experiments by Becke, the aim of which was to add to our knowledge of the connection between etching figures and crystalline structure. The same author had earlier studied the same subject in connection with sphalerite and galena. The minerals now experimented upon were magnetite, franklinite, spinel, and linnæite. The etching figures on boracite and cryolite have been anew studied by Baumhauer.

The following are some of the more important papers* on general physical mineralogy which cannot be briefly summarized, and hence are alluded to only: Mügge on change of position of crystalline planes, brought about by secondary twinning; Liebisch on the total reflection in doubly-refracting crystals; Voigt on the values obtained for the constants of elasticity of rock salt and fluor spar, and also on the explanation of the pleochroic phenomena of crystals; Beckenkamp on the methods of experiment in the determination of the constants of elasticity; Wulff on the effect of different kinds of movement upon crystallization; Blasius on the expansion of crystals with heat, and the same author on the decomposition figures of crystals; Schrauf on the double refraction of calcite; Curie on the formation of crystals and the capillary constants of their different faces; Dufet on the variation of refractive indices with heat; Danker on the experimental verification of the laws of total reflection deduced from Fresnel's laws of double refraction; Riecke on the pyro-electricity of tourmaline.

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* For full titles, see the bibliography at the close of the chapter.

CHEMICAL MINERALOGY.

Some interesting contributions have been made to the important part of chemical mineralogy dealing with the artificial formation of minerals. An extended paper by Doelter, of Graz, describes the formation of a number of sulphides, as galena, cinnabar, chalcocite, bornite, covellite, chalcopyrite, and pyrite, and also the sulphantimonites, miargyrite, jamesonite, and bournonite. The special object of the investigation was to accomplish the end aimed at under conditions and by methods as similar as possible to those that nature may be supposed to have employed; in other words, to avoid for the most part very high temperatures and the use of reagents that can hardly have entered into nature's processes. For example, it was shown that pyrite may be produced without essential elevation of temperature, by the action of water containing hydrogen sulphide upon hematite (Fe_2O_3), as also upon siderite ($FeCO_3$) and magnetite (Fe_3O_4). Similarly the experiments with galena lead to the conclusion that it could be produced in nature by hydrogen sulphide acting upon solutions of lead carbonate and lead chloride. Cubes of galena were formed in a tube containing lead chloride, hydrogen sulphide, and bicarbonate of soda, kept for five months at the ordinary temperature of the laboratory. Cinnabar was obtained in minute brilliant red crystals by digesting mercury in a sealed tube containing hydrogen sulphide for six days at a temperature of 70° to 90° C. Covellite (CuS) was produced from malachite in a sealed tube containing a hydrogen sulphide solution at 80° to 90°. Further, the same result was obtained by treating cupric oxide (CuO) with the gas (H_2S) in a glass tube at about 200°; at a higher temperature 250° to 400° chalcocite (Cu_2S) was formed. The other experiments were of a similar nature.

Wells and Penfield, in connection with their investigation of the new mineral, gerhardtite (see a later page), were led to study the formation and characters of an artificial basic cupric nitrate, having the same composition with it, viz, $4CuO, N_2O_5, {}_3H_2O$. The normal nitrate was heated with metallic copper in a sealed tube to about 150° C. for a day or more, the result being the formation of crystals of the compound named. These were tabular in habit, monoclinic in crystallization, but in dimensions, as, too, in optical properties, remarkably near the orthorhombic gerhardtite. The axial ratios, for example, are:

Gerhardtite	$\breve{a} : b : \acute{c} = 0{\cdot}9218 : 1 : 1{\cdot}1562$, $\beta = 90^\circ$
Artificial compound	$\grave{a} : b : \acute{c} = 0{\cdot}9178 : 1 : 1{\cdot}4102$, $\beta = 85^\circ\ 27$

Moreover, the cleavage corresponds, as also the plane of the optic axes; the dispersion, double refraction, and pleochroism also are similar. The same artificial compound, first correctly established by Gerhardt, was also made by Wells by adding sodium acetate to a hot dilute solution of cupric nitrate, boiling, then washing the precipitate in cold water; it consisted of minute crystals, having the same composition as that given.

De Schulten describes the formation of a hydrous phosphate of iron $Fe_2P_2O_8+4Aq.$ in rose-colored crystals, corresponding to the mineral strengite; strengite, however, is orthorhombic in crystallization, while these crystals were monoclinic. The same author has formed a magnesium hydrate (the mineral brucite) in six-sided tabular, or short prismatic crystals, optically uniaxial; also a similarly crystallized cadmium hydrate. Vater describes crystals of hematite, formed in the fire flues in the chemical manufactory in Schönebeck, near Madgeburg. Their formation is explained by the presence of pyrite and sodium chloride in the coal employed; from these iron chloride forms, which, in the cooled parts of the flues, is decomposed by the escaping water vapor with the result named. The crystals attain a magnitude of 2 millimeters.

The natural alteration of minerals is another chapter of chemical mineralogy which has received some attention. F. W. Clarke and J. S Diller have studied the changes of the topaz of Stoneham, Me. Their investigations cover both the chemical and microscopical sides, the sections under the microscope showing the progress of the alteration and the analyses what the results are. A series of analyses trace the changes from the unaltered topaz to the final product, massive or foliated potash mica (damourite). The fluorine lost by the topaz is believed by the authors to have led to the formation of the fluorite, herderite, triplite, and apatite of the locality. Cathrein has studied the changes undergone by the garnets of the amphibole schists of the Tyrolean Alps. The alterations described are very various, leading to the formation of scapolite, of epidote, oligoclase, hornblende, saussurite, and chlorite. Another interesting case of pseudomorphism is that of turquois after apatite. The specimens were from Taylor's ranch on the Chowcilla River, in Fresno County, California, and they are described by G. E. Moore and V. von Zepharovich. The crystalline form of the original mineral is distinct, a hexagonal prism, but the substance consists of a greenish-blue or bluish-green aggregate of minute spherulites with radiated and concentric fibrous structure. An analysis showed it to be a hydrous phosphate of alumina, with a little iron, and about 8 per cent. cupric oxide, corresponding approximately to an analysis by Church of a turquois from Nichabur. Still another case of pseudomorphism important especially in its geological relations is that of the *thinolite*, the crystalline calcareous tufa of Lake Lahontan, in Northwestern Nevada. This occurs, as is well known, on an immense scale, and the question of its origin is a vital one in the explanation of the geological changes of the region. It was referred to gay-lussite by Clarence King, but the writer shows from a crystallographic study of the forms remaining that it does not correspond to any known mineral, having a form which can be approximately referred to an acute tetragonal pyramid. The similarity of this to the pseudomorphs of lead carbonate after phosgenite (chloro-carbonate of lead) has suggested the hypothesis that the original mineral may have been an isomorphous chloro-carbonate of calcium.

It is also shown that the well-known but enigmatical "barley corn" pseudomorphs after calcite from Saugerhausen very probably had the same origin.

Still another case of pseudomorphism recently studied in detail is that of the rare mineral leucite, which is shown by Sauer to occur in an altered form extensively in the leucitophyr of the Saxon Erzgebirge. It is not found in a fresh state, but changed on the one hand to analcite and on the other to orthoclase and muscovite. Pseudomorphs of orthoclase from Magnet Cove, Arkansas, having the form of the familiar tetragonal trisoctahedron of garnet and leucite (2-2), have been referred to leucite by G. F. Kunz, but the subject requires further study before this suggestion can be accepted.

Of memoirs on the chemical composition of minerals, that by Rammelsberg on the scapolites deserves mention first. It follows the paper of Tschermak on the same subject, and while not removing all the difficulties from this most complex subject, it has at least the advantage that it does not deal so much with hypotheses as with facts. So far as can be explained in brief, his conclusion is that the various members of the scapolite group are to be regarded as combinations of the normal or meta silicates (bisilicates) Na_2SiO_3, $CaSiO_3$, $Al_2Si_3O_9$; of the orthosilicates (unisilicates) Na_4SiO_4, Ca_2SiO_4, $Al_2Si_3O_{12}$, and of the subsilicates $Na_2Si_2O_5$, $CaSi_2O_5$, $Al_2Si_6O_{15}$. Friedl discusses the composition of staurolite, giving new analyses of some pure varieties, with special reference to the oxidation of the iron. The formula adopted is that of a basic silicate with an oxygen ratio of 2 : 1, viz, $(Mg, Fe)_6\ Al_6(AlO)_{18}\ (OH)_4\ (SiO_4)_{11}$. The rare Vesuvian mineral nocerine has been analyzed by Lederer with the result of proving, as shown by Fischer, that it is an oxy-fluoride of calcium and magnesium, with also aluminum, sodium, and potassium, but, perhaps, not as essential constituents.

Dr. Genth's last paper, entitled *Contributions to Mineralogy*, contains analyses of a number of interesting minerals, as joseite, galenobismutite, argentobismutite (Silberwismuthglanz), cosalite, schirmerite, beegerite, polybasite, vanadinite, annabergite, &c. Koenig has given new analyses of cosalite, alaskaite, and beegerite from Colorado. H. F. and H. A. Kellar have published an analysis of a variety of kobellite from Colorado, interesting in containing 5 to 6 per cent. of silver, but no antimony. Analyses of several common American minerals are given by E. F. Smith, Knerr, and others in recent numbers of the American Chemical Journal. Claassen discusses in the same journal some vanadium-bearing magnetites. Other chemical results are noted in the paragraphs immediately following.

NEW MINERAL LOCALITIES IN THE UNITED STATES AND ELSEWHERE.

Perhaps the most interesting discovery of the year is that of the rare mineral, descloizite, in New Mexico, with also iodyrite, vanadinite, and endlichite. The locality is in Lake Valley, Donna Anna County, and the new occurrences are described chemically by Genth and crystallographically by vom Rath. The descloizite occurs in minute brilliant orange-red crystals; also in reddish chestnut-brown crystals up to 2^{mm} in size and associated with psilomelane and pyrolusite; and finally in blackish-brown to black crystals, which are sometimes 6^{mm} in size. The specimens analyzed conformed to the accepted formula of the species. The crystals are varied in habit, chiefly pyramidal; they are in some cases quite highly modified and *orthorhombic* in crystallization. The results of vom Rath thus differ from those of Websky, who made the species monoclinic. The question is one of interest, since the form of several of the minerals belonging in this libethenite-olivenite group is somewhat doubtful. It will probably be found that they are all orthorhombic. Descriptions are also given with analyses of the vanadinite and endlichite (see in the list of new minerals), and finally of the iodyrite.

The mineral arsenopyrite or mispickel is now being mined in large quantity at Deloro, Hastings County, Ontario. During the past year crystallized specimens have been obtained from there showing the cruciform twins observed from other localities (*e. g.*, the Binnenthal in Switzerland). The "fossil forest" of Arizona has also been developed recently as a source of agatized wood; beautiful polished specimens for table tops and other ornaments are now obtained from that source. A paper on the locality is given by G. F. Kunz, in a recent number of the Popular Science Monthly. Of more scientific interest is the discovery of zinc spinel, gahnite, at the pyrite mine in Rowe, Mass. Fine green octahedral crystals have been described and analyzed by A. G. Dana; associated with it, besides the pyrite, are epidote and rutile. G. F. Kunz has described in some detail the occurrence of native antimony in York County, New Brunswick, and of various copper minerals in Arizona. W. P. Blake mentions the fact that erythrite is found at Lovelock's Station, Union Pacific Railroad, in Nevada; also at the Kelsey mine, Compton, in Los Angeles County, California. W. E. Hidden describes phenacite from Florissant, El Paso County, Colorado; xenotime from the same locality; also a mineral assumed to be fayalite from Cheyenne Mountain, in the same State. The occurrence of minute crystals of fayalite in the obsidian of the Yellowstone Park is described by W. P. Iddings, as already noted. The same author, with Whitman Cross, shows that the otherwise rare mineral, allanite, is widely distributed as an accessory microscopic constituent of many rocks. The work of Penfield on crystals of tiemannite from Utah and metacinnabarite from California has already been spoken of, as also that of O. W. Huntington on crystals of azurite from Arizona. The bulletin of Cross and Hillebrand, already alluded to, contains many points in regard to the minerals of Colorado.

Of new foreign occurrences the following may be briefly alluded to: Fairfieldite, at Rabenstein, Bavaria, identical with the imperfectly described leucomanganite; nephrite, near the oriental stone in character, at

Jordansmühl, Silesia; monazite in crystals in Cornwall; also the rediscovery of the very rare mineral connellite, also in Cornwall. The long-known localities in Dauphiny, of antimony, octahedrite, axinite, epidote, turnerite (monazite), &c., have been recently described by Groth, giving interesting facts in regard to the relations of the different species.

NEW MINERALS.

*Avalite.**—This is announced by S. M. Losanitsch as a new chromium silicate, but, as will be seen, the investigation is too incomplete to establish its position as a new species very firmly. It is found at the mercury mines of Mount Avala, near Belgrade, Servia, associated with mercury, cinnabar, calomel, and so on. The material obtained for examination consisted of a green earthy mass, very impure, but from which, by repeated decantation and boiling with aqua regia, the clay, cinnabar, oxide of iron, &c., were separated, leaving only sand and chromite mixed with the mineral. This, partially purified, as described, was seen under the microscope to consist of thin crystalline plates of an emerald-green color. They were not attacked by acids, but were decomposed by hydrofluoric acid and also by fusion with an alkali carbonate; upon ignition it turned brown. Three analyses were made, of which that made upon the purest material is as follows:

SiO_2	Cr_2O_3	Al_2O_3	Fe_2O_3	K_2O	MgO	H_2O (hygr.)	Ign.	
56·13	14·59	14·37	1·10	3·54	0·43	2·39	5·38	chromite 1·68 = 99·61

Considering the nature of the material the attempt to calculate a formula is obviously of little use.

Cappelenite.—A preliminary announcement only of this mineral is given by W. C. Brögger. It is found in thick prismatic crystals, belonging to the hexagonal system, with a vertical axis equal to 0.4301. The planes observed, prismatic, and basal with two pyramids, were well polished. The color was brown, without distinct pleochroism, and the luster on the fracture surfaces greasy; the double refraction rather strong and the axis negative; specific gravity, 4·407. An analysis by P. T. Cleve gave the following results:

SiO_2	B_2O_3	Y_2O_3	$La_2(Di_2)O_3$	Ce_2O_3	ThO_2	BaO	CaO	Na_2O	K_2O	Ign.
14·16	[17·13]	52·55	2·97	1·23	0·79	8·15	0·61	0·39	0·21	1·81 = 100

It was found in a small vein in augite-syenite, on Lille Arö, in the Langesunds fjord, Norway, a locality which has afforded a large number of rare minerals of unusual composition; cappelenite is not less remarkable in these respects, and a fuller description will be awaited with interest.

Elpasolite.—This name is given by Cross and Hillebrand to a fluoride of aluminum and potassium, found sparingly in small cavities in the massive pachnolite of Colorado (report for 1884). It was observed in some rather obscure isometric crystals, but generally in a compact irregular mass, nearly colorless and isotropic. An imperfect analysis gave the following results:

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* For references see the list of mineral species following.

F	Al	Ca	Mg	K	Na
46·98	11·32	0·72	0·22	28·94	9·90=98·08

The alkalies were determined approximately only, and hence no attempt is made to calculate a formula, but it is suggested that it may be regarded as a cryolite, in which two-thirds of the sodium are replaced by potassium. Further investigation is to be desired. The name is from the county El Paso, which embraces the greater part of the Pike's Peak region.

Endlichite.—Among the specimens from the newly-described locality of descloizite, in Lake Valley, New Mexico, was a vandiferous mimetite to which Dr. Genth has given the name *Endlichite* (after Dr. F. M. Endlich). Like the related isomorphous species, mimetite, vanadinite, and pyromorphite, it occurs in hexagonal prismatic crystals. These are modified by pyramidal planes, both being strongly striated. The crystals are also sometimes hollow. An analysis was first made (I) of crystals of a yellowish-white or pale straw-yellow color, the largest 3^{mm} long and 0·5 to 1·5^{mm} thick. A second analysis was later made (II) of the same mineral, occurring in groups of crystals having a columnar structure. The color varied from white to yellowish-white, straw yellow, and at the extremities sometimes changing to deep orange red. The largest groups were 10^{mm} in length. The analyses were as follows: The material upon which the first was made consisted largely of impurity (76.4 per cent. quartz, &c.).

	As_2O_5	V_2O_5	Pb O	Cl
I	10·73	7·94	79·15	2·18=100
II (sp. grav.=6.864)	13·52	10·98	73·48	2·45 CaO 0·34, P_2O_5 *tr.*=100·77

The calculated formula is $Pb_5Cl\,(AsO_4)_3 + Pb_5Cl\,(VO_4)_3$, which requires: As_2O_5 11·86, V_2O_5 9·60, PbO 68·99, Pb 7.11, Cl 2·44=100.

Gerhardtite.—A new copper mineral, unique in that it is the only nitrate thus far known in nature, except the soluble nitrates of sodium, magnesium, &c.; it is described by H. L. Wells and S. L. Penfield. Only a single specimen has as yet been identified; this was from the United Verde copper mines, Jerome, Ariz., and consisted of pure massive cuprite, inclosing in a crack the crystals of gerhardtite and a few acicular crystals of malachite. The crystals belong to the orthorhombic system; they are pyramidal in habit, consisting of a zone of nine pyramids in oscillatory combination with the basal plane predominating, and the prism and a macrodome subordinate. There is a perfect basal cleavage and also a second cleavage parallel the macropinacoid. The mineral is very soft (hardness=2) and cleavage plates can be readily bent, then separating in the direction of the second cleavage. The specific gravity is 3·426. The color is dark green and the streak light green; transparent. The optic axes lie in a plane parallel to the brachypinacoid, and the bisectrix is negative and normal to the basal plane; the axial angle is large, 80° for green rays, measured in a solution of mercuric iodide in potassium iodide ($n = 1·722$). The pleochroism is distinct. An analysis yielded the following results:

N_2O_5	CuO	H_2O
22·76	66·38	11·26 = 100·40

The formula calculated, viz, $4CuO, N_2O_5, 3H_2O$, requires N_2O_5 22·52, CuO 66·22, H_2O 11·56 = 100, agreeing closely with the results of analysis. The mineral is named after the chemist who first determined the true composition of the corresponding artificial compound. This artificial salt, as noted on a previous page, has also been made by Wells and Penfield and shown to crystallize in the monoclinic system; the form, however, is rather closely related to that of the orthorhombic gerhardtite.

Graphitoid.—This name has been given by Sauer to a substance which he regards as amorphous carbon. It occurs extensively in the mica schists and phyllites of the Saxon Erzgebirge. It forms loose incrustations on the surfaces of the schist, shows no crystalline structure, and burns with comparative rapidity in a Bunsen burner. An analysis of the combustible substance gave—carbon, 99·76; hydrogen, 0·24 = 100; showing that it is essentially pure carbon. Besides occurring as an incrustation it also impregnates the rock mass, forming fine bands of minute particles passing in parallel directions through the irregular quartz grains. The author recognizes the fact that true graphite is also a common constituent of many archæan rocks, but suggests that with it the graphitoid may also be present. A related form of amorphous carbon was described a few years ago by von Inostranzeff, also from phyllite.

Hanksite.—A new anhydrous sulphato-carbonate of sodium, described by W. E. Hidden, obtained from San Bernardino County, California, where it occurs with thenardite, borax, &c. It is named after Mr. Henry G. Hanks, State mineralogist of California. Hanksite crystallizes in the hexagonal system, the crystals being short hexagonal prisms with one or two pyramids and the basal plane; they sometimes form confused groups of tabular six-sided crystals. Optically it is uniaxial, negative. The hardness is 3—3·5, and the specific gravity 2·562. The color is white, inclining to yellow; the crystals nearly transparent, though sometimes inclosing impurities. An analysis by J. B. Mackintosh gave the results under I, below; another analysis by S. L. Penfield, made two years since upon a large crystal from California (exact locality unknown), is given under II.

	SO_3	CO_2	Cl	Na_2O	
I........................	45·89	5·42	2·36	46·34 =	100·01
II........................	43·59	5·42	2·13	40·86	K 2·33, insol. 4·41, ign. 1·32 = 100·06

The chloride of sodium (or potassium) shown in the analyses is probably present as impurity. Excluding this the composition becomes: $4Na_2SO_4 + Na_2CO_3$, which requires Na_2SO_4 84·27, Na_2CO_3 15·73 = 100.

Hydrogiobertite (Idrogiobertite).—As the name indicates (from 'υδωρ, *water*, and giobertite, a synonym of magnesite), this is a new hydrous carbonate of magnesium; it is from Vesuvius, and is described by Eugenio Scacchi. The mineral was found in the interior of a mass of augitophyre, in the neighborhood of Pollena. It appears in spherical forms from 2 to 15 millimeters in diameter. These have a compact texture and a light gray color. The specific gravity varies from 2·149—2·174. Small crystals of magnetite are imbedded in the spheres, both in the surface and in the mass. Two analyses were made, with the following results:

CO_2	MgO	H_2O
25·16	44·91	29·93=100
25·29	44·28	30·43=100

Both analyses have been calculated to 100, after deducting the small amount of impurity present (magnetite, &c.). They correspond closely to the formula $Mg_2CO_4 + 3aq$, which requires: CO_2 24·72, MgO 44·94, H_2O 30·34=100. The nearest related minerals are hydro-magnesite ($Mg_4C_3O_{10} + 4aq$) and the doubtful lancasterite.

Låvenite (or *Lovenite*).—This new mineral, also announced by W. C. Brögger, is like cappelenite (above), from an island in the Langesunds fjord, Norway. It is found in prismatic crystals belonging to the monoclinic system. The axial ratio deduced is, $a : b : c : = 1·0811 : 1 : 0·8133$, and the obliquity $\beta = 71° 24\frac{1}{2}'$; the form, consequently, is somewhat related to that of pyroxene. The cleavage is perfect parallel to the orthopinacoid. The optic axes lie in the plane of symmetry, the acute bisectrix being inclined forward about 20½° to the vertical axis. The color is chestnut-brown to yellowish, with marked pleochroism. The specific gravity is 3·51. An analysis by P. T. Cleve gave:

SiO_2	ZrO_2	Fe_2O_3 (?)	MnO	CaO	Na_2O	ign.
33·71	31·65	5·64	5·06	11·00	11·32	1·03 = 99·41

It is somewhat related in composition to the hexagonal catapleiite, but contains less silica.

Pinnoite.—Described by H. Staute as a new magnesium borate. It is probably to be regarded only as a decomposition product of boracite. It occurs at Stassfurt intimately associated with white earthy boracite. It has an even fracture with a glistening surface, and sometimes shows traces of a fibrous structure; magnified slightly it appears fine-granular to compact, with occasional crystalline planes. The color is sulphur-yellow to straw-yellow, sometimes pistache-green; also at times it has a grayish or reddish tinge. The hardness is 3 to 4; the specific gravity 2·27. The mean of several analyses by Staute and Stromeyer gave:

B_2O_3	MgO	H_2O	Fe	Cl
[42·50]	24·45	32·85	0·15	0·18

Other analyses of different samples gave concordant results, all agreeing with the formula $MgB_2O_4 + 3H_2O$, which requires: B_2O_3 42·69, MgO 24·39, H_2O 32·92.

Polyarsenite-Sarkinite.—These are two minerals described independently by different authors, from different localities, and yet very closely related, if not identical. *Polyarsenite*, named by Igelström in allusion to its large amount of arsenic, is from the Sjö mines in the Grythyttan parish, Sweden. It has a yellowish-red color, is transparent, but shows no crystalline form and no cleavage; an optical examination by Bertrand shows that it is biaxial, with an angle of 83° and a negative bisectrix; specific gravity 4·085. It is found in granular form, associated with a little barite, and also hematostibiite in veins in calcite embedded in tephroite. An analysis by Söderbaum is given below.

Sarkinite, named by A. Sjögren from σάρκινος (bloody, fat), with a double allusion to its blood-red color and greasy luster, is from the iron-manganese mines of Pajsberg, Sweden. Its hardness is 4 to 5, and specific gravity 4·14. Two cleavages were observed, but no crystals were found, and the system is thus in doubt; optically, however, it is biaxial. An analysis was made by C. H. Lundström, and for the sake of comparison it is placed beside that of polyarsenite.

	As_2O_5	Sb_2O_5	P_2O_5	MnO	FeO	CaO	MgO	H_2O	
Polyarsenite ($\frac{3}{2}$) .	39·05	1·20	....	50·18	tr.	2·88	0·75	3·15	CO_2 3·51 = 100·72
Sarkinite........	41·60	...	0·21	51·60	0·13	1·40	0·98	3·06	insol. 0·38, PbO 0·25, CO_2 0·76 = 100·37

For the former Cleve calculates $4MnO, As_2O_5 + H_2O$, which requires: As_2O_5 43·23, MnO 53·38, H_2O 3·39 = 100.

Uintahite—This name has been given by W. P. Blake to a peculiar variety of asphaltum which occurs in considerable quantities in the Uintah Mountains. It is obtained in masses several inches in diameter; it breaks with a conchoidal fracture, is brittle and easily reduced to powder in a mortar. The hardness is 2 to 2·5, and the specific gravity 1·065 to 1·070. The color is black and the surface brilliant and lustrous. It fuses easily in the flame of a candle and burns with a brilliant flame, resembling sealing-wax, and like this it gives a clean, sharp impression with a seal. It gives off upon distillation a small quantity of a clear white dense oil and a little vapor. It is soluble in heavy lubricating petroleum, while the lighter products of the petroleum do not affect it. It is soluble also in warm oil of turpentine, but not in ordinary alcohol, and in ether only when powdered. In melted wax it dissolves, forming on cooling a hard black mixture resembling "burnt wax." It is suggested that it may prove to be useful in various ways in the arts. A more complete chemical examination is needed to establish its true character.

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Ann. Ch. Phys.—Annales de Chimie et de Physique, Paris.

Am. J. Sc.—American Journal of Science, New Haven.

Ann. Min.—Annales des Mines, Paris.

Am. Phil. Soc. Philad.—American Philosophical Society of Philadelphia. Proceedings.

Ber. Ak. Berlin.—Sitzungsberichte der kais. preuss. Akademie der Wissenschaften, Berlin.

Ber. Ak. München.—Sitzungsberichte der kais. bayerischen Akademie der Wissenschaften, Munich.

Ber. Ak. Wien.—Sitzungsberichte der kais. Akademie der Wissenschaften, Vienna.

Ber. d. chem. Ges.—Berichte der deutschen chemischen Gesellschaft, Berlin.

Boll. Com. Geol.—Bolletino Comitato Geologico d' Italia, Rome.

Bull. Cal. Acad. Sc.—Bulletin of the California Academy of Science.

Bull. Soc. Ch.—Bulletin de la Société chimique, Paris.

Bull. Soc. Min.—Bulletin de la Société minéralogique de France, Paris.

Ch. News.—Chemical News, London.

C. R.—Comptes Rendus de l'Académie des Sciences, Paris.

Eng. Min. J.—Engineering and Mining Journal, New York.

Geol. För. Förh.—Geologiska Förening i Stockholm Förhandlingar.

Jahrb. geol. Reichs.—Jahrbuch des k. k. geologischen Reichsanstalt, Vienna.

Jahrb. Min.—Neues Jahrbuch für Mineralogie, etc.

Journ. Am. Ch. Soc.—Journal of the American Chemical Society, New York.

J. Phys.—Journal de Physique, Paris.

Min. Mag.—Mineralogical Magazine and Journal of the Mineralogical Society of Great Britain.

Min. petr. Mitth.—Mineralogische und petrographische Mittheilungen gesammelt von G. Tschermak, Vienna.

N. Y. Acad. Sci.—New York Academy of Sciences.

Oefv. Ak. Stockh.—Oefversigt af k. Vet. Akad. Förhandlingar, Stockholm.

Wied. Ann.—Annalen der Physik und der Chemie, Wiedemann, Leipzig.

Zs. geol. Ges.—Zeitschrift der deutschen geologischen Gesellschaft, Berlin.

Zs. gesammt. Wiss.—Zeitschrift für die gesammten Wissenschaften, Halle.

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Schrauf, A. Ueber die Azimuthdifferenz doppeltbrechender Strahlen. Beobachtungen am Calcit. Zs. Kr., xi, 5.

Voigt, W. Erklärung der Farbenerscheinung pleochroitscher Krystalle. Jahrb. Min., i, 119.

Neue Bestimmungen der Elasticitätsconstanten für Steinsalz und Flusspath. *Ibid.*, Beil.-Bd. iv, 228.

WEBSKY, M. Ueber die Ein- und Mehrdeutigkeit der Fundamental-Bogen-Complexe für die Elemente monoklinischer Krystall-Gattungen. Jahrb. Min., I, 79.

WULFF, L. Wachsen der Krystalle nur durch Juxtaposition neuer Molekeln. Zs. Kr., X, 374.

Krystallisation in Bewegung. Zs. Kr., XI, 120.

WYROUBOFF, G. Quelques considérations sur l'isomerie et le polymorphisme. Bull. Soc. Min., VIII, 398.

NECROLOGY OF MINERALOGISTS: 1885.

E. E. SCHMID.—Born May 22, 1815, at Hildburghausen; died at Jena February, 1885; for many years professor at Jena. His work was largely in geology, but he made many contributions to mineralogy, chiefly of a chemical nature.

BENJAMIN SILLIMAN.—Born December 4, 1816; died January 14, 1885; professor of chemistry in Yale College, New Haven, Conn. He was an editor of the American Journal of Science for nearly fifty years; author of works on chemistry and physics and of many papers upon American minerals, especially the minerals of the Western States and Territories

RECORD OF NORTH AMERICAN INVERTEBRATE PALÆONTOLOGY.

By John Belknap Marcou.

INTRODUCTORY NOTE.

The same general plan has been followed as last year, although the scope of the work has been somewhat enlarged so as to include also reviews and bibliographic notices of palæontologic works; mere mentions of works by title have not been referred to. I have experienced some difficulty in getting hold of all the recent publications in time for insertion in this record, and there are doubtless some omissions. I shall be much obliged if those who notice them will call my attention to them so that they may be inserted next year. I wish to thank all those who have kindly aided me in collecting this material, and especially Mr. H. M. Ami, of the Canadian Survey, and Mr. C. E. Beecher, of the New York State Museum at Albany.

Aldrich, T. H.—Notes on the Tertiary of Alabama and Mississippi with descriptions of new species. *Jour. Cincinnati Soc. Nat. Hist.*, vol. VIII, pp. 145–153, pls. ii, iii (pars). July, 1885. Cincinnati.

Describes and illustrates a number of new species from the Eocene; mostly from the Red Bluff formation of the Vicksburg group. *Solecurtus vicksburgensis*, *Murex* (*Pteronotus*) *angelus*, *Pleurotoma* (*Surcula*) *longiforma*, *P. Heilprini*, *P. anita*, *Turbinella* (*Caricella*) *reticulata*, *Cassis* (*Semicassis*) *shubutensis*, *Strombus* (*Canarium*) *Smithii*, *Scaphander primus*, *Triton* (*Simpulum*) *conradianus*, *Buccinum vicksburgensis*, *Conus* (*Conorbis*) *alatoideus*, *Fasciolaria jacksonensis*, *Turritella bellifera*, *Cerithium Langdoni*, *Triforis americanus*, *Fusus pearlensis*, *Scalaria Whitfieldi*, *Cassidaria brevidentata*, *C. dubia*.

Aldrich, T. H.—Notes on Tertiary Fossils, rare, or little known. *Jour. Cincinnati Soc. Nat. Hist.*, vol. VIII, pp. 153–155, pl. iii (pars). July, 1885. Cincinnati.

These illustrated notes on Eocene shells are given with the hope of correcting some errors, shedding light upon obscure forms and recording the European species mentioned. The author intends to continue them with notes on synonomy.

ALDRICH, T. H.—Observations upon the Tertiary of Alabama. *Amer. Jour. Sci.*, 3d ser., vol. xxx, pp. 300–308. October, 1885. New Haven.

The results of a personal examination of the Tertiary of Alabama are given so far as is necessary to reply to Dr. Meyer's papers; his quotations and views are also criticised and corrected. (*See* Meyer, Otto.)

AMI, H. M.—List of Fossils from Ottawa and Vicinity. *Ottawa Field Naturalists' Club Trans.*, No. 5, vol. II, No. i, pp. 54–62. 1884. Ottawa.

Gives lists of fossils from the following formations: Cambro-Silurian system, Chazy formation, Bird's Eye and Black River formation, Trenton formation, Utica formation,—Post-Tertiary, Leda clay, and Saxicava sand, alluvium (shell marl deposit).

AMI, H. M.—Additional Notes on the Geology and Palæontology of Ottawa and Vicinity. *Ottawa Field Naturalists' Club Trans.*, No. 6, vol. II, No. ii, pp. 251–259. 1885. Ottawa.

ANON.—The Oldest Air-breathers. *Pop. Sci. Monthly*, vol. XXVII, pp. 395–400, figs. 1–5, and pp. 397, 399, and 400. July, 1885. New York.

An account of the oldest fossil insects; the facts and illustrations are borrowed from the French and English scientific journals.

ANON.—Proceedings of the section of Geology and Geography. *Science*, vol. VI, No. 136, p. 220. 1885. Cambridge.

Science's report of the proceedings of the meeting of the A. A. A. S. at Ann Arbor.

Three discoveries of fossils were announced. Prof. N. H. Winchell brought from the pipe-stone quarry of Minnesota a contorted trilobite of the *Paradoxides* type and slabs of sandstone covered with round phosphatic brachiopods referred provisionally to *Lingula*. Prof. W. B. Dwight reported the discovery of a unique Potsdam locality one mile northwest of Vassar College and in the Wappinger limestone belt. Prof. J. D. Dana exhibited Silurian fossils taken at Canaan, N. Y., from the sparry limestone of Emmons, a member of his original Taconic system as first defined by him in 1842. Prof. James Hall said that the existence of Silurian fossils in these rocks was claimed and admitted forty years ago, and Prof. N. H. Winchell argued that Emmons's later use of the title "Taconic," in which he applied it to certain rocks in New York, now known to be pre-Silurian, entitled the name to a place in stratigraphic nomenclature.

BAIN, FRANCIS, and DAWSON, J. W. (Sir).—Notes on the Geology and Fossil Flora of Prince Edward Island. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 154–161, figs. 1 and 2, on pp. 160 and 161. 1885. Montreal.

Communicated to the Royal Society of Canada at its meeting in Ottawa, May, 1885. Sir William Dawson describes the new species *Walchia imbricatula* from the Trias; Sir William concludes that Mr. Bain's lower series is distinctly permo-Carboniferous; that its extent is considerably greater than was supposed in 1871; that there is a well characterized overlying Trias, and that the intermediate series, whether Permian or Lower Triassic, is of somewhat difficult local definition; but that its fossils, so far as they go, lean to the Permian side.

BEECHER, C. E.—List of Species of Fossils from an Exposure of the Utica slate and associated rocks within the limits of the city of Albany. *Thirty-sixth Rep. New York State Mus. Nat. Hist.*, p. 78. 1884. Albany.

BILLINGS, W. R.—Two new species of Crinoids. *Ottawa Field Naturalists' Club Trans.*, No. 6, vol. II, No. ii, pp. 248–250, pl. i. 1885. Ottawa.

Describes and figures *Archaeocrinus desideratus* and *Euspirocrinus obconicus* from the Trenton.

BILLINGS, W. R.—Report of the Palæontological Branch. *Ottawa Field Naturalists' Club Trans.*, No. 6, vol. II, No. ii, pp. 259–262. 1885. Ottawa.

A large number of additions, hitherto not recorded, are mentioned from the Cambro-Silurian rocks about Ottawa.

BRITTON, N. L.—Cretaceous Plants from Staten Island. *Trans. N. Y. Acad. Sci.*, vol. V, 1885–'86, pp. 28–29. November, 1885. New York.

Notes the discovery by Messrs. H. Hollick, W. T. Davis, and himself of fossil leaves in the Cretaceous clays at Kreischerville, Staten Island. The specimens were obtained from a stratum of lignitic clay about 18 inches in thickness, and included angiosperms and conifers.

BRITTON, N. L., and HOLLICK, ARTHUR.—Leaf-bearing Sandstones on Staten Island, New York. *Trans. N. Y. Acad. Sci.*, vol. III, 1883–'84, pp. 30, 31. 1885. New York.

Dr. Britton considers the sandstones of Cretaceous age, although the fossils are insufficient for proper determination. Similar fossiliferous sandstones occur on the beaches about Glen Cove, Long Island, and vicinity.

BRONGNIART, CHARLES.—Les Insectes Fossiles des Terrains Primaires, Coup d'œil rapide sur la faune entomologique des terrains paléozoiques. *Bulletin de la Société des Amis des Sciences Naturelles de Rouen*, 3^e^ série, Vingt et unième année, 1^er^ semestre, 1885, pp. 50–68, pls. i–iii. 1885. Rouen.

American as well as European forms are discussed in this review of Palæozoic insects. Some new forms are named, but they are all from Commentry.

Brongniart, Charles.—The Fossil Insects of the Primary Rocks: A Rapid Survey of the Entomological Fauna of the Palæozoic Period. *Geol. Mag., New Series, Decade* III, vol. II, pp. 481–491, pl. xii. November, 1885. London.

Translated and read before the Manchester Geological Society, October 6, 1885, by Mark Stirrup, F. G. S., Hon. Sec. Revised and reprinted by permission of the author and translator, with a plate from the *Bulletin de la Société des Amis des Sciences Naturelles de Rouen* (année, 1885, 1er semestre). The article contains discussions of the American as well as of the European forms.

Call, R. E.—On the Quaternary and recent Mollusca of the Great Basin, with descriptions of new forms. Introduced by a sketch of the Quaternary Lakes of the Great Basin, by G. K. Gilbert. *Bull. U. S. Geol. Surv.*, No. 11, pp. 1–66, pls. i–vi. 1885. Washington.

Gives a systematic catalogue of the recent and Quaternary shells of the Great Basin, a discussion of their environment and geographic and chronologic distribution, and concludes (1) that the recent and the fossil mollusca are predominantly limnaeid, a biologic expression of climate; (2) that the fossil fauna is more variable than the recent; in the Lahontan area being characteristically limnaeid (represented by *Pompholyx effusa*), and in the Bonneville area rissoid (represented by *Amnicola porata* and *A. cincinnatiensis*); (3) that increase in salinity finds a biologic expression in depauperation, in lessened abundance, and in extinction when the waters become briny; (4) that the oscillations of the lakes are coupled with varying abundance, and with varying size of shells as a biologic expression of climate.

Limnophysa bonnevillensis, from the Bonneville Lake beds, is the only new fossil species described.

Carpenter, P. H.—Further Remarks upon the Morphology of the Blastoidea. *Annals and Magazine of Natural History*, 5th ser., vol. xv, pp. 277–300, fig., p. 293. April, 1885. London.

An answer to and a criticism of Mr. G. Hambach's article entitled "Contribution to the Anatomy of the Genus Pentremites, with Descriptions of New Species." *Trans. Saint Louis Acad. Sci.*, vol. IV, No. i, 1881, pp. 145–160, pls. A and B.

Clarke, J. M.—A Brief Outline of the Geological Succession in Ontario County, New York, to accompany a map. *Rep. State Geologist* for 1884, pp. 9–22. 1885. Albany.

Gives lists of fossils occurring in the different Devonian formations.

Clarke, J. M.—On the Higher Devonian Faunas of Ontario County. New York. *Bull. U. S. Geol. Survey*, No. 16, pp. 1–86, pls. i–iii. 1885, Washington, Twenty-six new species of invertebrates are described in this paper, which is divided under the following heads, viz:

(1) Bibliography of the formations here discussed, viz, the Genesee, the Naples, the Portage, and the High Point Chemung rocks of New York.

(2) The Petrographic and Palæontologic Characters of the Genesee Beds.

(3) Review of the Fauna and Flora of the Genesee Shales. Here the following new species are described: *Goniatites nodifer*, *Beyrichia Dagon*, *Goniatites astarte*, *Orthoceras Stebos*, *O. Mephisto*, *O. Asmodeus*, *Platyostoma Belial*, *Loxonema* (?) *Moloch*, *Modiomorpha* (?) *Chemos*, *Spirifera Belphegor*, *S. Pluto*, *Leiorynchus* (?) *Hecate.*

(4) The Petrographic and Palæontologic Characters of the Naples Beds.

(5) Review of the Fauna and Flora of the Naples Beds. Here the following new species are described: *Ceratiocaris simplex*, *C. Beecheri*, *Echinocaris Whitfieldi*, *Goniatites Lutheri*, *Orthoceras aciculoides*, *O. Ontario*, *O. filosum*, *Bellerophon incisus*, *Trochus* (*Palæotrochus*) *præcursor*, *Platyostoma* (?) *minutissimum*, *Loxonema Noe*, *Hyolithes Napolis*, *Lingula triquetra*, *Aulopora annectens.*

(6) The Petrographic and Palæontologic Characters of the Portage Beds.

(7) A List of the Fossils occurring in the Genesee, Naples, and Portage Beds of Ontario County, with the names of species heretofore identified from the horizons elsewhere in the State of New York, but not as yet known within this district. From these tables he concludes that the Naples shales have no such palæontologic relation to the rocks of the Chemung period as to justify the union of them with these rocks; that their fauna and flora is more closely allied to those of the Hamilton shales, and that therefore these beds are to be regarded either as constituting the uppermost member of the Hamilton period or, together with the Genesee shales, representing a distinct geological epoch. The more probable conclusion is that these two groups of strata represent the epoch of the lower Upper-Devonian in Western New York.

(8) Fauna of Chemung Beds at High Point. It is unfortunate that six of the new species described are not illustrated in any manner.

CLAYPOLE, E. W.—On the Vertical Range of certain Fossil Species in Pennsylvania and New York. *Amer. Nat.*, vol. XIX, pp. 644–654. July, 1885. Philadelphia.

(1) Remarks on certain criticisms by Prof. James Hall, of Albany, in the preface to volume G7 of the Pennsylvania reports, on the palæontological portion of the work in the volume. Mr. Claypole states that there is no doubt that in Perry County spirifers, unbroken and with both valves in contact, are found about 1,000 feet above red sandstone beds holding the scales of *Holoptychius* or *Bothriolepis* or both. (2) The author states that *Spirifera disjuncta*, *S. mesocostalis*, *S. mesostrialis*, though evidently characterizing, probably, in some places, by their abundance,

certain zones, are not by any means limited to these zones, but invade each other's territory to an undefined extent; and that *Spirifera lævis* occurs in Middle Pennsylvania higher than the Portage group in the Chemung proper, and in company with *S. mesocostalis* (?) (3) The author doubts whether there is any distinct character by which *Orthis tulliensis* can be separated from *O. impressa*, and he states on Professor Williams's authority that there is in New York an *Orthis* which cannot be distinguished from *O. tulliensis*, occurring not at 200 feet only, but at a yet greater height (less than 500 feet) above the Genesee shale. (4) The author states that there is no doubt that *Halysites catenulatus* occurs in the Lower Helderberg limestone at the place mentioned by Prof. I. C. White, and that there is no doubt as to the stratigraphical position of the bed in which it occurs. (5) The author concludes that all attempts to confine the range of species within certain arbitrary limits are attempts that are not likely to succeed, and that the artificial systems of palæontology which have been constructed by the faithful, earnest, and devoted labors of the students of the science are but temporary.

Cooper, J. C.—On Fossil and Subfossil Land Shells of the United States, with Notes on Living Species. *California Academy of Sciences*, pp. 235–255. October 13, 1885. [San Francisco.]

Calls attention to the lack of post-tertiary changes that have occurred in the species of the Atlantic slope and to the striking changes in those of the Pacific slope, even in recent times and presumably ever since the Tertiary epochs. He mentions the occurrence of similar changes on the islands and some parts of the main-land of Western Europe and Africa, and says: "In searching for a common cause of variations affecting the west slopes of both continents similarly, we arrive at the conclusion that it is change of climate, produced by Tertiary and recent geological action, and are obliged to admit that such action is still going on." The absence of such action to any marked extent on the Atlantic slope of the United States he considers the cause of the lack of any changes in the land shells there.

Dall, W. H.—Miocene Deposits in Florida. *Science*, vol. VI, No. 130, p. 82. July, 1885. Cambridge.

Notes the discovery of *Ecphora quadricostata* at Tampa, by Dr. R. E. C. Stearns, and says that it is probable that there is a large area in Florida corresponding in age to what has been called Miocene in Virginia and the Carolinas.

Dall, W. H.—Notes on some Floridan Land and Fresh Water Shells, with a Revision of the Auriculacea of the Eastern United States. *Proc. U. S. Nat. Mus.*, vol. VIII, pp. 255, 289, pls. xvii, xviii. July 1, 1885. Washington.

In this paper Mr. Dall mentions some forms that are found fossil as well as recent.

DALL, W. H.—List of Marine Mollusca comprising the Quaternary Fossils and recent forms from American localities between Cape Hatteras and Cape Roque, including the Bermudas. *Bull. U. S. Geol. Survey*, No. 24, pp. 1–336. 1885. Washington.

A bibliography of the works consulted in making up this list is also given.

DAMES, W.—E. W. Claypole: On the Occurrence of the Genus Dalmanites in the Lower Carboniferous Rocks of Ohio. *Geol. Mag.*, 1884, pp. 303–307 und Holzschnitte. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, p. 102. Stuttgart. (Abstract.)

DAMES, W.—Ch. D. Walcott: Appendages of the Trilobite. *Science*, vol. III, No. 57, 1884, pp. 279–281. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, p. 102. Stuttgart. (Abstract.)

DAMES, W.—R. Jones and J. W. Kirby: On some Carboniferous Entomostraca from Nova Scotia. *Geol. Mag.*, 1884, pp. 356–362, t. XII. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, pp. 106, 107. Stuttgart. (Abstract.)

DAMES, W.—Rupert Jones and H. Woodward: Notes on Phyllopodiform Crustaceans, referable to the Genus Echinocaris, from the Palæozoic Rocks. *Geol. Mag.*, 1884, pp. 393–396, t. XIII. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, p. 110. Stuttgart. (Abstract.)

DAMES, W.—C. H. E. Beecher: Ceratiocaridæ from the Chemung and Waverly Groups at Warren, Pa. Report of Progress PPP, Second Geol. Survey of Pennsylvania, Harrisburg, 1884, pp. 1–22, & 1 u. 2. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, pp. 110, 111. Stuttgart. (Abstract.)

DAMES, W.—J. Mickleborough: Locomotary Appendages of Trilobites. *Geol. Mag.*, 1884, p. 80–84. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, p. 477. Stuttgart. (Notice of.)

[DANA, J. D.].—Why are there no Fossils in the Strata preceding the Cambrian? *Amer. Jour. Sci.*, 3d ser., vol. XXX, p. 78. July, 1885. New Haven.

Criticises Mr. Charles Morris's view that the earliest animals, like the youngest stage of animal life generally, had no hard parts to preserve, and that the sudden appearance of tribes was simply the appearance of species having hard or stony secretions. One difficulty in the way of the theory is presented by the existence of limestone formations of great extent in the Archean which most geologists suppose to be of organic origin, and the existence also of phosphate of lime in large quantities which also is material of possible organic origin. (*See* Morris, Charles.)

[DANA, J. D.].—Cambrian or Primordial Rocks in the Eastern Part of British Columbia. *Amer. Jour. Sci.*, 3d ser., vol. XXX, p. 79. July, 1885. New Haven.

Notes Mr. Winwood's description in the *Geol. Mag.* for May of a Primordial fauna from near Stephen, on the Canadian Pacific Railway. (*See* Winwood, H. H.)

[DANA, J. D.].—*Spiraxis major* and *Sp. Randalli* of Newberry; large screw-like fossils from the Chemung group of Northern Pennsylvania and Southern New York. *Amer. Jour. Sci.*, 3d ser., vol. XXX, p. 244. September, 1885. New Haven.

Notes Dr. Newberry's description of these forms, and the fact that he gives no decided opinion as to their biological relations. (*See* Newberry, J. S.)

DANA, J. D.—Lower Silurian Fossils at Canaan, N. Y. *Science*, vol. VI, No. 139, p. 283. October, 1885. Cambridge.

States that Prof. James Hall did not mean the beds at Canaan by the term "these limestones" used in the *Science* report of his remarks on Professor Dana's paper at the meeting of the A. A. A. S. at Ann Arbor, but referred to his knowledge of fossils at Hoosic, 40 miles north of Canaan, in a limestone which he regarded as of the same age with that of Canaan.

[DANA, J. D.].—New American Limuloid Species from the Carboniferous. *Amer. Jour. Sci.*, 3d ser., vol. XXX, p. 401. November, 1885. New Haven.

Notice of Prof. A. S. Packard's article in the *American Naturalist* for March, 1885.

DARTON, N. H.—Preliminary Notice of Fossils in the Hudson River Slates of the Southern Part of Orange County, New York, and elsewhere. *Amer. Jour. Sci.*, 3d ser., vol. XXX, pp. 452–454. December, 1885. New Haven.

Gives lists of the few fossils found near Sugar Loaf Village, at Rock Tavern and near Walden.

DAWSON, G. M.—Bowlder Clays. On the microscopic structure of certain bowlder clays and the organisms contained in them. *Bull. Chicago Acad. Sci.*, vol. I, No. VI, pp. 59–69, figs. 1–3 on p. 62. 1885. Chicago.

The author mentions the occurrence of various organisms in certain bowlder clays at different localities, and figures certain supposed Annelid jaws from bowlder clays of Chicago and vicinity.

DAWSON, J. W. (Sir).—On Rhizocarps in the Palæozoic Period. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 19–27, fig. 23. 1884. Montreal.

This paper was read before the A. A. A. S., August 16, 1883, at Minneapolis.

The author describes two species of *Sporangites* from Brazil, discusses their occurrence in various parts of North America, and concludes that the facts he enumerates do not furnish any positive proof that the abundant *Sporangites* of the Erian period were the fructification of Rhizocarps, but they establish a certain probability of this, and invite to further researches.

DAWSON, J. W. (Sir).—Notes on Eozoön Canadense. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 58, 59. 1884. Montreal.

Abstract of a paper read before the British Association in 1883, at Southport.

The author stated that the Eozoön, in its ordinary condition as mineralized by serpentine, presents the simplest kind of mineralization of a calcareous fossil; that in which the original calcite walls still exist, with no change except a crystallization of the calcite, common in the fossils of newer formations, and with the cavities filled with a hydrous silicate, which was evidently in process of deposition on the sea-bottom on which Eozoön is supposed to have lived.

DAWSON, J. W. (Sir).—The Mesozoic Floras of the Rocky Mountain Region of Canada. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 141–143. 1885. Montreal.

Abstract of a paper read before the Royal Society of Canada, May, 1885. (*See* other abstracts and reviews of the same paper.)

DAWSON, J. W. (Sir).—Ancient Insects and Scorpions. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 207, 208. 1885. Montreal.

A notice of the discovery of insects in the Silurian, that the Spanish *Protoblattina* suggests the existence of Silurian forests producing some kind of succulent and nutritious vegetable food, while it also furnishes an explanation of the possible means of sustenance of the carnivorous scorpions.

DAWSON, J. W. (Sir).—A Modern Type of Plant in the Cretaceous. *Science*, vol. V, No. 125, p. 514, fig. on p. 514. June, 1885. Cambridge.

Describes and figures *Brasenice antiqua*, from the Upper Cretaceous of the South Saskatchewan River. The specimens come from the Belly River series of the Canadian survey near Medicine Hat. These beds are Upper Cretaceous, and hold fossils some of which resemble those of the Laramie group; others those of the Pierre group. The author himself assisted at the disinterment of a Dinosaur of the genus *Diclonius* from beds overlying those in which the leaves occur.

DAWSON, J. W. (Sir).—A Jurasso-Cretaceous Flora in the Rocky Mountains. *Science*, vol. v, No. 125, pp. 531, 532. June, 1885. Cambridge.

Notes the discovery of this fauna by Dr. G. M. Dawson, in the Rocky Mountains, on the branches of the Old Man River, Martin Creek, Coal Creek, and one other locality far to the northwest on the Suskwa River. Sir William proposes for the beds containing it the name of Kootanie group. They can be traced for a distance of 140 miles north and south in the troughs of the palæozoic formations of the mountains. The plants found are conifers, cycads, and ferns, the cycads being especially abundant. Some are identical with species described by Heer from the Jurassic of Siberia, while others occur in the Lower Cretaceous of Greenland. No dicotyledonous leaves have been found in these beds.

DAWSON, J. W. (Sir).—The Cretaceous Floras of Canada. *Nature*, vol. XXXIII, pp. 32–34. 1885. London and New York.

From the advance sheets of a memoir to appear in the *Transactions of the Royal Society of Canada.* The author first discusses the geological relations of the floras, and gives, on page 33, a table showing the "successive floras and subfloras of the Cretaceous in Canada (in descending order"). This table ranges from the Upper Laramie or Porcupine Hill series, containing the Platanus beds of Souris River, Calgary, down to the Neocomien (?) Kootanie series of the Rocky Mountains, containing cycads, pines, and ferns. The author then dicusses the physical conditions and climate indicated by the Cretaceous floras.

DAWSON, J. W. (Sir).—Sir William Dawson on the Mesozoic Floras of the Rocky Mountain Region of Canada. *Amer. Nat.*, vol. XIX, pp. 699, 700. July, 1885. Philadelphia.

An abstract of a paper read before the Royal Society of Canada, May, 1885. The paper refers more particularly to a remarkable Jurasso-Cretaceous flora recently discovered by Dr. G. M. Dawson in the Rocky Mountains, and to intermediate groups of plants between this and the Middle Cretaceous, serving to extend greatly our knowledge of the Lower Cretaceous flora, and to render more complete the series of plants between this and the Laramie. (*See* Dawson, Sir William.)

DAWSON, J. W. (Sir).—On the Mesozoic Floras of the Rocky Mountain Region of Canada. *Trans. Roy. Soc. Canada* (vol. III), section iv, 1885, pp. 1–22, pls. i–iv. 1885. Montreal.

Considers the flora of the Laramie group to be that of the newest Cretaceous. Describes a new flora of Jurasso-Cretaceous age found by Dr. G. M. Dawson, which undoubtedly represents the flora of the lowest Cretaceous, which has not hitherto been recognized in Western America, and proposes to name it the Kootanie series. The following new forms are described: *Dicksonia sp., Asplenium Martinianum, Zamites Montana, Z., sp., Sphenozamites sp., Salisburia* (*Gingko*) *nana, Taonurus incertus;* from the intermediate series, *Sterculia vetustula;* from the Mill Creek or upper series, *Dicksonia Munda*, *Asplenium albertum*, *Williamsonia recentior*, *Platanus affinis* var. *ampla*; *Cinnamonium Canadense*, *Aralia rotundata*, *A. Westoni*, *Paliurus montanus*, *P. ovalis*, *Juglandites cretacea*; from the Belly River and Laramie group, *Brasenice antiqua*, *Populus latidentata*, *Acer Saskatchewense*, *Abietites Tyrrellii*, *Platanus* (*Araliopsis*) *Burpeana*, *Viburnum oxycoccoides*, *V. Calgarianum*, *Salisburia sp.*

FONTAINE, WILLIAM M.—Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. *Annals and Magazine of Natural History*, 5th series, vol. XVI, pp. 517–519. December, 1885. London.

Notice and abstract of Professor Fontaine's monograph of the U. S. Geol. Surv., vol. VI.

FONTAINE, WILLIAM M.—Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. *Pop. Sci. Monthly*, vol. XXVIII, p. 129. November, 1885. New York.

A notice and very brief abstract of Professor Fontaine's monograph of the U. S. Geol. Surv., vol. VI.

FORD, S. W.—Note on the Age of the Slaty and Arenaceous Rocks in the Vicinity of Schenectady, Schenectady County, New York. *Amer. Jour. Sci.*, 3d ser., vol. XXIX, pp. 397, 398. May, 1885. New Haven.

The author refers these beds to the age of the Utica group on palæontologic grounds. They have formerly been considered as belonging to the epoch of the Lorraine shales. He finds *Lingula curta* a Utica species, and other fossils.

FORD, S. W.—(Note on the Age of the Slaty and Arenaceous Rocks in the Vicinity of Schenectady, Schenectady County, New York.) *Nature*, vol. XXXII, p. 116. 1885. London and New York.

Notice and abstract of Mr. Ford's paper in the *Amer. Jour. Sci.*, 3d ser., vol. XXIX, pp. 397, 398.

GARDNER, J. S.—The Cretaceous and Tertiary Floras of the United States, by Leo Lesquereux (U. S. Survey of the Territories under F. V. Hayden, vol. VII). *Nature*, vol. XXXIII, pp. 196, 197. 1885. London and New York.

A brief review of Professor Lesquereux's important work.

GEYLER, H. T.—Lester F. Ward: On Mesozoic Dicotyledons. *Ann. and Magaz. of Nat. History*, 1884, vol. XIII, No. 77, pp. 383–395. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band II, pp. 219, 220. Stuttgart. (Abstract.)

GURLEY, W. F. E.—New Carboniferous Fossils. Bulletin No. 2, pp. 1–12. February 25, 1884. (Danville, Ill.)

Describes a number of fossils from his own collection, no illustrations accompanying the descriptions. The following genera and species are established: *Troostocrinus Wachsmuthi*; the new genus *Cucumulites*, with the following types: *C. tuberculatus* and *C. tricarinatus*; the new genus *Cidarospongia*, with the type *C. Ella*; the new genus *Ptychostylus*, with the types *P. heterocostalis* and *P. subtumidus*. The above new genera are all placed in the Protista. *Discina Keokuk*, *Lepetopsis Parrishi*, *Bellerophon Ourayensis*, *B. incomptus*, *B. nodocostatus*, *B. tenuilineatus*, *B. rugopleurus*.

HALL, JAMES.—Note on the Intimate Relations of the Chemung Group and Waverly Sandstone in Northwestern Pennsylvania and Southwestern New York. *Proc. A. A. A. S.*, vol. XXXIII, part ii, pp. 416–419. 1885. Salem.

(Abstract.) Gives a list of the Waverly genera of fossils. Without any apparent want of conformity the Waverly follows the Chemung, but at the point in the section marked "Place of the Catskill" there is a hiatus which, in Eastern New York and Pennsylvania, is marked by the presence of measures having a thickness of from 3,000 to 5,000 feet. Therefore we have a right to conclude that there has been a long interval in time between the final deposition of the barren Chemung shales and the fossiliferous Waverly sandstone, or that the deposition of the estuary Catskill sediments has been going on simultaneously with the open sea deposits of the Waverly formation.

HALL, JAMES.—Note on the Eurypteridæ of the Devonian and Carboniferous Formations of Pennsylvania; with a supplementary note on the *Stylonurus excelsior*. *Proc. A. A. A. S.*, vol. XXXIII, part ii, pp. 420–422. 1885. Salem.

The geologic range of the genus, so far as at present known, is from the Clinton group, where we have an unpublished species (*Eurypterus prominens*)—to the Coal Measures. Gives a tabular view of the geological distribution of the family Eurypterdæ in the United States. Gives a note on the size and occurrence of *Stylonurus excelsior*, Hall.

HALL, JAMES.—Note on the Eurypteridæ of the Devonian and Carboniferous Formations of Pennsylvania. 2d *Geol. Surv. Pennsylvania*, Rep. of Progress P. P. P., pp. 23–39, pls. iii–viii, figs. 2–4, on pp. 25, 27, and 34. 1884. Harrisburg.

Discusses the Eurypteridæ, gives a tabular view of the geological distribution of the family in the United States, and describes *Eurypterus Beecheri* from the Chemung, *E. stylus* from the Alleghany River series, and names and figures, but does not mention in the text, *E. potens*, pl. iv, figs. 9 and 10.

HALL, JAMES.—Classification of the Lamellibranchiata. *Rep. State Geologist* for 1881, pp. 8–15, pls. i–xi. 1884. Albany.

The plates are intended to represent the characteristic generic forms and to convey in a measure some idea of the variety of forms embraced in each genus of Devonian Lamellibranchiata.

Hall, James.—Discussion upon the Manner of Growth, Variation of Form, and Characters of the Genus Fenestella, and its Relations to Hemitrypa, Polypora, Retepora, Cryptopora, &c. *Rep. State Geologist* for 1882, pp. 5–16, figs. 1–36 on pp. 9, 10, 12, 13, 15. 4to. 1883. Albany.

Redefines the genus *Fenestella*, and includes in it *Retepora, Phyllopora, Leptopora, Reteporina, Fenestrellina, Hemitrypa.* For continuation of article, see *Rep. State Geologist* for 1884, pp. 35–45. 1885. Albany.

Hall, James.—Fossil Corals and Bryozoans of the Lower Helderberg Group and Fossil Bryozoans of the Upper Helderberg Group. *Rep. State Geologist* for 1882, p. 17, pls. i–xxxiii. 4to. 1883. Albany.

These plates are photolithographed and published with their explanations in advance of vol. VI, Palæontology of New York.

Hall, James.—Brachiopoda: Plates and Explanations. *Rep. State Geologist* for 1882, pls. xxxiv–LXI. 4to. 1883. Albany.

These plates are photolithographed and published with their explanations in advance of vol. IV, part ii, Palæontology of New York.

Hall, James.—Description of the Bryozoans of the Hamilton Group. (Fenestellidæ excepted.) *Rep. State Geologist* for 1883, pp. 5–61. 1884. Albany.

The following new species are described: *Callopora bipunctata, Thallostigma multaculeata, Lichenalia cultellata, Stictopora crenulata;* then Stictopora is described as a subgenus on p. 48; *S.* (s. g.?) *dichotoma* n. sp., is described under it.

Most of the species and genera in this article were more briefly described in the *Trans. Albany Institute,* vol. x, pp. 179–197. 1883. Albany.

Hall, James.—Notice of the Machinery and Methods of Cutting Specimens of Rocks and Fossils at the New York State Museum of Natural History. 35th *Rep. New York State Mus. Nat. Hist.*, pp. 121–124, pls. i, ii, and xvi. 1884. Albany.

Plates i and ii contain figures of the machinery used, and plate xvi contains figures and translucent sections of fossil corals made by the method explained. The illustration of *Tetradium Ontario* is marked as a new species.

Hall, James.—Preliminary Notice of the Lamellibranchiate Shells of the Upper Helderberg, Hamilton, and Chemung Groups. Preparatory for the Palæontology of New York, part i. 35th *Rep. New York State Mus. Nat. Hist.*, pp. 215–406f. 1884. Albany.

A separate issue of this paper was also published with five plates on generic illustrations taken from the *Report of the State Geologist* for 1882.

Published in advance of Palæontology of New York, vol. V, part i. Noticed last year.

HALL, JAMES.—Description of Fossil Corals from the Niagara and Upper Helderberg Groups. 35th *Rep. New York State Mus. Nat. Hist.*, pp. 407–464, pls. xxiii–xxx. 1884. Albany.

The following new species are from the Niagara group: *Streptelasma ?* (*Zaphrentis ?*) *exstans*, *S. ?* (*Z. ?*) *limitare*, *Ptychophyllum floriforme*, *P. fulcratum*, *Chonophyllum vadum*, *C. capax*, *Hallia scitula*, *H. divisa*, *H. divergens*, *H. pluma*, *Anisophyllum unilargum*, *A. trifurcatum*, *A. ? bilamellatum*, *Zaphrentis rigida*, *Z. cristulatum*, *Z. pressula*, *Z. latisinus*, *Z. subvada*, *Amplexus uniforme*, *A. junctum*, *Cyathaxonia columellata*, *C. Herzeri*, *Cyathophyllum intertrium*, *C. bullulatum*, *Heliophyllum gemmiferum*, *H. pravum*, *H. dentilineatum*, *H. mitellum*, *H. puteatum*, *Cystiphyllum granilineatum*, *Calceola pusilla*, *Cyathospongia excrescens*. *Cyathospongia* is a new genus and is described as one of the *Petrospongiæ*.

The following new species are from the Upper Helderberg group: *Streptelasma lamellatum*, *S. tenue*, *S. dissimile*, *S. inflatum*, *S. simplex*, *S. laterarium*, *S. ampliatum*, *S. conspicuum*, *S. fossula*, *S. crateriforme*, *S. involutum*, *S. æquidistans*, *S. mammiferum*, *S. papillatum*, *S. coarctatum*, *Ptychophyllum versiforme*, *P. striatum*, *Aulachophyllum convergens*, *A. prateriforme*, *A. pinnatum*, *A. princeps*, *A. cruciforme*, *A. præciptum*, *A. reflexum*, *A. tripinnatum*, *A. trisculactum*, *A. poculum*, *A. bilaterale*, *Zaphrentis inequalis*, *Z. complanata*, *Z. cyathiformis*, *Z. ponderosa*, *Z. tabulata*, *Z. corrugata*, *Z. subcompressa*, *Z. Colletti*, *Z. planima*, *Z. fusiformis*, *Z. ovalis*, *Z. spissa*, *Z. torta*, *Z. fastigata*, *Z. trisutura*, *Z. profunda*, *Z. nitida*, *Z frequentata*, *Z. duplicata*, *Z. sentosa*, *Z. calcariformis*, *Z. constricta*, *Z. annulata*, *Z. Knappi*, *Z. foliata*, *Z. inclinata*, *Z. irregularis*, *Z. concava*, *Z. Herzeri*, *Z. curvata*, *Z. gravis*, *Z. transversa*, *Z. elegans*, *Z. convoluta*, *Z. contorta*, *Z. venusta*, *Elasmophyllum* (new genus), *type E. attenuatum*, *Cyathophyllum* (*Elasmophyllum*) *intervesiculum*, *C. exfoliatum*, *C. canaliculatum*, *C. impositum*, *C. depressum*, *C. arctifossa*, *C. vesiculatum*, *C. bullatum*, *C. cohærens*, *C. septatum*, *C. perfossulatum*, *C. concentricum*, *C. scalenum*, *C. perplicatum*, *C. robustum*, *Blothrophyllum multicalicatum*, *B. papulosum*, *B. sinuosum*, *B. promissum*, *Heliophyllum alternatum*, *H. incrassatum*, *H. acuminatum*, *H. venatum*, *H. imbricatum*, *H. verticale*, *H. invaginatum*, *H. æquale*, *H. fasciculatum*, *H. annulatum*, *H. compactum*, *H. dentatum*, *H. fecundum*, *H. gemmatum*, *H. latericrescens*, *H. pocillatum*, *H. distans*, *H. lineolatum*, *H. æquum*, *H. scyphulus*, *H. tenuimurale*, *H. Nettebrothi*, *H. sordidum*, *H. denticulatum*, *H. campaniforme*, *H. fissuratum*, *H. cancellatum*, *Dyphyphyllum adnatum*, *D. cylindraceum*, *D. apertum*, *D. breve*, *D. tumidulum*, *Cystiphyllum bipartitum*, *C. bifurcatum*, *C. muricatum*, *C. quadrangulare*, *C. tenuiradius*, *C. namum*, *C. latiradius*, *C. supraplanum*, *C. crateriforme*, *C. pustulatum*, *C. infundibulum*, *C. obliquum*, *C. scalatum*, *C. striatura*, *Coleophyllum* new genus, types *C. Romingeri* and *C. pyriforme*.

Only Upper Helderberg species are illustrated, and the illustrations of these stop at *Zaphrentis Herzeri* in the above list.

HALL, JAMES.—Illustrations of the Microscopic Structure of Brachiopoda. 35th *Rep. New York State Mus. Nat. Hist.*, pl. xxii. 1884. Albany.

These illustrations are presented to show the principal varieties of structure of the strophomenoid Brachiopoda. They represent a portion of the work which is being done for the elucidation of shell structure preparatory for the volume of Palæontology on the Revision of the Brachiopoda. The specimens are prepared and photographed, and the accompanying figures were drawn on stone from photographic prints.

HALL, JAMES.—Bryozoa (Fenestellidæ) of the Hamilton Group. 36th *Rep. New York State Mus. Nat. Hist.*, pp. 57–72. 1884. Albany.

The following new species are described: *Fenestella multiplex*, *F. latitruncata*, *F. fistulata*, *F. aspectus*, *F. angustata*, *F. marcida*, *F. planiramosa*, *F. cinctuta*, *F. perundulata*, *F. assita*, *F. inflexa*, *F. perforata*, *F. scalaris*, *F. exornata*, *F. quadrangula*, *F. emaciata*, *F. curvata*, *F. brevilinea*, *F. subtortilis*, and *F. strata*.

HALL, JAMES.—On the Structure of the Shell in the Genus Orthis. 36th *Rep. New York State Mus. Nat. Hist.*, pp. 73–75, pls. iii, iv. 1884. bany.

With his present knowledge the author makes three groups of Orthis, according to their shell structure, the non-punctate, the distinctly punctate, with distinct rows of punctæ coming out along the summit of the radii, and the highly punctate. Excellent figures of shell sections are given.

HALL, JAMES.—Description of a New Species of Stylonurus from the Catskill Group. 36th *Rep. New York State Mus. Nat. Hist.*, pp. 76, 77, pl. v. 1884. Albany. (Describes *Stylonurus excelsior.*)

[HALL, JAMES].—Description of a New Genus from Greenfield, Saratoga County, New York. 36th *Rep. New York State Mus. Nat. Hist.*, pl. vi. 1884. Albany.

Describes the new genus *Cryptozoon*, with *C. proliferum* as its type. The generic and specific description are on the page of the explanation of the plate. There is no name connected with it, but the author is presumably James Hall.

HALL, JAMES.—On the Mode of Growth and Relations of the Fenestellidæ. *Rep. State Geologist* for 1884, pp. 35–45, pls. i, ii; figs. a–i, p. 39; 1–2, p. 40; A–E, p. 41; A, p. 42; 1–10, pp. 43–45. 1885. Albany.

Continued from page 14 of the *Report of the State Geologist* for 1882. Assembly document No. 178, 1883.

The author proposes the following subgenera: *Fenestropora*, *Ptyloporina*, *Ptyloporella*, *Unitrypa*, *Isotrypa*. Gives at length his reasons for not recognizing the generic value of *Carinopora* and *Cryptopora* Nicholson. A considerable number of figures have been prepared, but not yet lithographed, to illustrate this paper on the *Fenestellidæ.* These will appear in a future report.

[HALL, JAMES].—On the Relations of the Genera Stictopora, Ptilodictya, Acrogenia, and Allied Forms in the Palæozoic Rocks of New York. *Rep. State Geologist* for 1884, p. 46; figs. 1–3, p. 46. 1885. Albany.

To be printed with the next report of the State Geologist. Figures 1, 2, and 3 are typical forms of *Stictopora, Ptilodictya,* and *Acrogenia.*

[HALL, JAMES].—Note (on some Palæozoic Pectenoid Shells). *Rep. State Geologist* for 1884, pp. 47, 48; figs. 1–6, p. 46. 1885. Albany.

These wood-cuts were prepared for the report of the State Geologist for 1882. They were not completed in time for insertion in that report and are introduced in this place with their explanations. Figs. 1 and 2, *Aviculopecten;* figs. 3 and 4, *Pterinea flabella;* fig. 5, *Actinopteria decussata;* and fig. 6, *Aviculopecten exacutus.*

HEILPRIN, ANGELO.—Town Geology. The Lesson of the Philadelphia Rocks. Studies of Nature along the Highways and among the Byways of a Metropolitan Town, pp. 1–142, pls. i–vii. 1885. Philadelphia.

Chapter x is on the fossils of the marl, or life in the Cretaceous period, containing popular descriptions of the groups; plates iv and v contain figures of the Cretaceous invertebrate fauna.

HEILPRIN, ANGELO.—The Classification and Palæontology of the U. S. Tertiary Deposits. *Science*, vol. v, No. 124, pp. 475, 476. June, 1885. Cambridge.

A protest against the acceptance of Dr. Otto Meyer's views in his "Genealogy of the Species of the Older Tertiary Formations," and a warning to palæontologists not to accept his numerous new species.

HEILPRIN, ANGELO.—The Classification and Palæontology of the U. S. Tertiary Deposits. *Science*, vol. VI, No. 130, pp. 83, 84. July, 1885. Cambridge.

Contains further criticisms of Dr. Otto Meyer's paper, and reiterates his warning to geologists and palæontologists against the acceptation of his views.

HILGARD, E. W.—The Classification and Palæontology of the U. S. Tertiary Deposits. *Science*, vol. VI, No. 128, p. 44. July, 1885. Cambridge.

Note on Dr. Otto Meyer's paper in the *Amer. Jour. Sci.*, and on Mr. A. Heilprin's notice of it in *Science.* The author enters a caveat on both sides of the question, sympathizes with Dr. Meyer's views in respect to the transition of so-called species from one of the stages to another, but emphatically agrees with Heilprin as to the impossibility of subverting the accumulative stratigraphic evidence, to the effect that the relative superposition of the several principal stages—the Buhrstone, Claiborne, Jackson, and Vicksburg groups—cannot be otherwise than as heretofore ascertained in hundreds of localities by others as well as by himself.

HILGARD, E. W.—The Old Tertiary of the Southwest. *Amer. Jour. Sci.*, 3d ser., vol. XXX, pp. 266–269. October, 1885. New Haven.

Criticises Dr. Otto Meyer's views as expressed in the June and July numbers of this journal. Does not attach much importance to *Plagiostoma dumosum* as a significant fossil. Considers *Arca Mississippiensis* as the most characteristic Vicksburg fossil. For the Jackson age the most constant fossil is the *Zeuglodon* and also *Venericardia planicosta*, which has nowhere been found associated with the characteristic Vicksburg fauna. Through this widely diffused and universally recognized shell, as well as through the almost equally constant *Gastridium vetustum* and *Calyptrophorus velatus* as common fossils, the Jackson fauna connects strikingly with the Claiborne and Buhrstone beds, and the author has found this *Venericardia* in the latter in almost immediate contact with the Upper Cretaceous rocks of North Mississippi. Upon Dr. Meyer's assumption, the Vicksburg beds, void of both of the above types, would actually be intercalated between this oldest post-Cretaceous fauna and the Claiborne and Jackson beds. However, his assumption is abundantly and conclusively disproved by the most direct stratigraphical evidence.

HINDE, G. J.—Description of a New Species of Crinoids with Articulating Spines. *Annals and Magazine of Natural History*, 5th ser., vol. XV, pp. 157–173, pl. vi, and fig. p. 163. March, 1885. London.

Describes the new genus *Hystricrinus=Arthroacantha*, Williams, invalid, and the new species *Hystricrinus Carpenteri* from the Middle Devonian at Arkona, Ontario, Canada. The peculiarity of the species consists in movable spines.

HINDE, G. J.—Notice of Hystricrinus Carpenteri, a Crinoid with Articulating Spines. *Amer. Nat.*, vol. XIX, p. 706. July, 1885. Philadelphia.

This specimen, from calcareous shales of the Middle Devonian at Arkona, Ontario, was described by Mr. G. J. Hinde in the *Ann. and Mag. Nat. Hist.*, March, 1885. The genus is identical with *Arthrocanthus* (Williams), a name preoccupied among the *Rotatoria*.

HYATT, ALPHEUS.—Structure of the Siphon in the Endoceratidæ. *Proc. A. A. A. S.*, vol. XXXIII, part ii, pp. 490, 491. 1885. Salem.

Abstract. Describes the structure of the siphon of *Endoceras* and refers to that of *Actinoceras*, and adds a third type of syphon in a new genus which he calls *Choanitoceras*, the syphon of which is not ascertained, the remains being exclusively those of the hard, unyielding endosiphon and sheaths.

HYATT, ALPHEUS.—Structure and Affinities of Beatricea. *Proc. A. A. A. S.*, vol. XXXIII, part ii, p. 492. 1885. Salem.

Abstract. This remarkable fossil has a cellular structure similar to the Foramenifera, and possesses stolons, uniting these cells with each other.

HYATT, ALPHEUS.—[Letter relative to the Pteropods of the Saint John Group.] *Bull. Nat. Hist. Soc. New Brunswick*, No. IV, p. 102. 1885. Saint John, New Brunswick.

States that a certain form is a *Hyalothis*, allied to *H. undulatus* Barrande. The aspect of a syphon is due to the compression of the sharper against the flatter side and the form of the sutures, which favors this impression. These fossils with their distinct septa are remarkably similar to certain forms of Nautiloidea, but there is no syphon. They, however, confirm Von Jhernig's and the author's opinion that the Orthoceratites and Pteropods have had a common, but as yet undiscovered, ancestor in ancient times.

HYATT, ALPHEUS.—[Letter relative to the Pteropods of the Saint John Group] *Canadian Rec. Sci.*, vol. I (1884–'85), p. 141. 1885. Montreal.

This letter also appeared in the *Bull. Nat. Hist. Soc. New Brunswick*, No. IV, p. 102. 1885. Saint John, New Brunswick.

HYATT, ALPHEUS.—Larval Theory of the Origin of Cellular Tissues. *Proc. Boston Soc. Nat. Hist.*, vol. XXIII, March 5, 1884, pp. i–iv and 45–163. (1885. Boston.)

The hypothesis of the common but independent origin of types is also supported by all collateral evidences. The results of palæontologic research have carried back the origin of distinct types farther and farther every year. It is now established that there was an excessively sudden appearance of vast numbers of forms in the Cambriam or perhaps earlier, as claimed by Prof. J. Marcou. The author has applied this specific statement as a generalization to the history of smaller groups of fossils in several branches of the animal kingdom, and in many formations, and has found that the sudden appearance of the smaller groups occurs according to the same law. The early geologic history of animal life, like the early stages of development in the embryo, was a more highly concentrated and accellerated process in evolution than that which occurred at any subsequent period of the earth's history. The great mass of life as shown by the fossils has been progressive, and the progress was similar to that of the individual from a more generalized to more and more specialized conditions and structures. The primitive stocks, like the primitive Metazoa, the Porifera, were certainly much more variable and unstable than the later and more complicated forms, which are more stable and less susceptible of change. Thus, when radical changes become necessary in order to sustain the life of the species of a group, they die out as did the Ammonites, or decay as did the Nautiloids, and exhibit most clearly the stability they have acquired as progressive forms in their inability to meet the requirements of different modern conditions.

JAMES, J. F.—Fucoids of the Cincinnati Group. *Jour. Cincinnati Soc. Nat. Hist.*, vol. VII, pp. 151–166, pls. vii, viii. January, 1885. Cincinnati.

Describes the new species *Cruziana Carleyi*, and finishes reviewing the already described fossil algæ of the group. The author concludes that there is not a single one entitled to remain in the class. They are referred to three different sources: first, inorganic causes; second, to trails and burrows; third, and last, to the Hydrozoa.

JAMES, J. F.—Are there any Fossil Algæ? *Amer. Nat.*, vol. XIX, pp. 165–167. February, 1885. Philadelphia.

The author seems to consider that there are no fossil algæ, and that it is unreasonable to expect to find any.

JAMES, J. F.—Remarks on a supposed Fossil Fungus from the Coal Measures. *Jour. Cincinnati Soc. Nat. Hist.*, vol. VIII, pp. 157–159. October, 1885. Cincinnati.

The author holds that *Rhizomorpha sigillariæ* Lesquereux is not a fungus, but the burrow left under the bark by the grub of some one of the species of insects flourishing at the time of the deposition of the coal, and refers to the burrows made by species of *Scolytus* under the bark of species of hickory as possessing the same characteristics and appearances as the fossil.

JAMES, J. F.—Remarks on some Markings on the Rocks of the Cincinnati Group, described under the names of Ormathicuus and Walcottia. *Jour. Cincinnati Soc. Nat. Hist.*, vol. VIII, pp. 160–162. October, 1885. Cincinnati.

The author considers that *Ormathicuus* Miller is not the track made by a Gasteropod, but was really made by a crinoid stem. The author thinks this is shown conclusively by a specimen found near Cincinnati by Mr. U. P. James containing a part of the crinoid stem which he considers made the mark. The genus Walcottia Miller and Dyer, two of whose species are considered as crinoid-stem impressions, and the third as probably a burrow, is "consigned to the limbo of the improbable."

James, J. F.—Remarks on the Genera Lepidolites, Anomaloides, Ischadites, and Receptaculites from the Cincinnati Group. *Jour. Cincinnati Soc. Nat. Hist.*, vol. viii, pp. 163–166. October, 1885. Cincinnati.

The author considers *Lepidolites* (Ulrich) a synonym of *Ischadites* Murchison, and *Anomaloides* Ulrich a synonym of *Receptaculites* Defrance.

Julien, A. A.—A study of Eozoön Canadense, Filed Observations. *Proc. A. A. A. S.*, vol. xxxiii, part ii, pp. 415, 416. 1885. Salem.

Abstract. A description was given of the lithologic characteristics of the rocks inclosing and associated with *Eozoön Canadense* at various localities. The inclosure of pyroxene (or malachite) within the serpentine was described at a new locality for Eozoön, Seillant's apatite mine near Cote Saint Pierre.

Karsch, Franz.—Samuel H. Scudder. The Species of Mylacris, a Carboniferous Genus of Cockroaches. *Mem. Bost. Soc. Nat. Hist.*, vol. iii, No. ix, 1884, pp. 299–309, pl. xxvii, fig. 5–11. Boston. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 178, 179. Stuttgart. (Abstract.)

Karsch, Franz.—Samuel H. Scudder: A New and Unusually Perfect Carboniferous Cockroach from Mazon Creek, Illinois. *Proc. Bost. Soc. Nat. Hist.*, vol. xxi, pt. iv, 1882, pp. 391–396. (1883. Boston.) *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, p. 178. Stuttgart. (Abstract.)

Karsch, Franz.—Samuel H. Scudder: Older Fossil Insects West of the Mississippi. *Proc. Bost. Soc. Nat. Hist.*, vol. xxii, pt. i, 1882, pp. 58–60. (1883. Boston.) *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 177, 178. Stuttgart. (Abstract.)

Karsch, Franz.—Samuel H. Scudder: Notes on some of the Tertiary Neuroptera of Florrisant and Colorado, and Green River, Wyoming Territory. *Proc. Bost. Soc. Nat. Hist.*, vol. xxi pt. iv, 1882, pp. 407–409. (1883. Boston.) *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 176, 177. Stuttgart. (Abstract.)

Karsch, Franz.—Samuel H. Scudder: Two New and Diverse Types of Carboniferous Myriopods. *Mem. Bost. Soc. Nat. Hist.*, vol. iii, No. ix, pp. 283–297. 1884. Boston. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 175, 176. Stuttgart. (Abstract.)

Karcsh, Franz.—Samuel H. Scudder: Archipolypoda, a subordinate type of spined Myriopods from the Carboniferous formation. *Mem. Bost. Soc. Nat. Hist.*, vol. iii, No. v, pp. 143–182, pl. x–xiii. 1882. Boston. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 174, 175. Stuttgart. (Abstract.)

KARSCH, FRANZ.—Samuel H. Scudder: A Contribution to our knowledge of palæozoic Arachnida. *Proceed. of the American Academy of Arts and Sciences*, vol. XX (N. S. XII), 1884, pp. 13–22. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band II, pp. 172, 173. Stuttgart. (Abstract.)

KUNZ, G. F.—On the Agatized Woods and the Malachite, Azurite, &c., from Arizona. *Trans. N. Y. Acad. Sci.*, vol. V, 1885–'86, pp. 9–12. October, 1885. New York.

Describes the silicified forest in Arizona known as Chalcedony Park, situated 8 miles south of Corriza, Apache County, Arizona. Remarks that the wood structure has been perfectly preserved even to the forms of the minute cells.

LESQUEREUX, LEO.—Contributions to the Fossil Flora of the Western Territories, part III. The Cretaceous and Tertiary Floras. *Rep. U. S. Geol. Surv. Territories*, F. V. Hayden, U. S. Geologist in charge, vol. VIII, pp. i–vi and 1–283, pls. i–lix. 4to. 1883. Washington.

This important work was not published till February, 1885, although it bears the imprint 1883. It is divided into four parts, as follows, viz:

I. The flora of the Dakota group:

(1) General remarks. Concludes that the first appearance and apparent simultaneous multiplication of the dicotyledonous plants remains a fact inconceivable to reason.

(2) Description and enumeration of species of the American Dakota group formation. The following new species are described: *Equisetum nodosum*, *Podozamites oblongus*, *P. prælongus*, *P. emarginatus*, *P. caudatus*, *Torreya oblanceolata*, *Thuites crassus*, *Myrica Sternbergii*, *Quercus dakotensis*, *Q. morrisoniana*, *Ficus Beckwithii*, *F. ? angustata*, *F. magnoliæfolia*, *F. Glascæna*, *Lomatia Saporteana*, var. *longifolia*, *Laurus ? modesta*, *Sassafras* (*Araliopsis*) *dissectum*, *S.* (*A*) *platanoides*, *Aralia subemarginata*, *A. tenuinervis*, *A. radiata*, *Cissites salisburiæfolius*, *Hamamelites tenuinervis*, *H. quercifolius*, *H.* (?) *cordatus*, *Magnolia* sp. *Liriophyllum obcordatum*, *Carpites liriophylli ?*, *Anona cretacea*, *Menispermites acutilobus*, *M. grandis*, *Sterculia lugubris*, *S. aperta*, *Sapindus Morrisoni*, *Rhamnus prunifolius*, *Leguminosites cultriformis*, *Aspidiophyllum dentatum*, *A. platifolium*, *Carpolithes* species. ?

(3) Table of distribution of the plants of the Cretaceous Cenomanian formation.

(4) Relationship of the flora of the Dakota group. The author concludes that the marked analogy in the components of the floras authorizes the conclusion of equivalency of the age of the Dakota group with that of the Quader sandstone of Germany, which is as positively determined as Cenomanian by its animal fossils as the Dakota group is recognized as Middle Cretaceous by the invertebrate remains which abound in the strata of the Fort Benton group immediately overlying it.

II. Flora of the Laramie group:

(1) States that the flora has a relation, remarkably well defined, with that of Sezanne. Says that the age of the Laramie group of Hayden is not yet definitely determined. The flora, like the invertebrate fauna, is on the whole of a peculiar character, uniformily distributed over the whole extent of the formation, and free from any types or characters relating it to the Cretaceous flora. As the Laramie group has never been subjected to submersion in the deep sea, the few remains of Dinosaurians found in it are derived from low marine lagoons penetrating into the land, and cannot impress the formation with the Cretaceous character.

(2) Table of distribution of the species of the Laramie group.

(3) Description of species added to the flora of the Laramie group. The following new species are described: *Osmunda major*, *Oreodoxites plicatus*, *Aralia pungens*, *Anona robusta*, *Zizyphus Beckwithii*, *Rhamnus deformatus*.

III. The flora of the Green River group:

(1) Geological distribution of the measures.

(2) Enumeration and description of the species of fossil plants known from the Green River group. The following new species are described: *Chara ? glomerata*, *Fontinalis pristina*, *Isoetes brevifolius*, *Sphenopteris Guyottii*, *Adiantites gracillimus*, *Pinus Florissanti*, *Widdringtonia linguæfolia*, *Cyperites Haydenii*, *Potamogeton ? verticillatus*, *Najadopsis rugulosa*, *Lemna penicillata*, *Flabellaria Florissanti*, *Palmocarpon ? globosum*, *Myrica obscura*, *M. rigida*, *M. callicomæfolia*, *M. fallax*, *M. Scottii*, *M. diversifolia*, *M. Alkalina*, *Betula Florissanti*, *B. truncata*, *Alnus cordata*, *Ostrya betuloides*, *Carpinus attenuata*, *C. fraterna*, *Quercus Osbornii*, *Q. pyrifolia*, *Q. castaneopsis*, *Salix amygdalæfolia*, *S. Libbeyi*, *Ulnus Hilliæ*, *U. Brownellii*, *Celtis McCoshii*, *Ficus tenuinervis*, *F. alkalina*, *Santalum Americanum*, *Banksites lineatus*, *Lomatia hakeæfolia*, *L. spinosa*, *L. terminalis*, *L. tripartita*, *L. acutiloba*, *L. abbreviata*, *L. interrupta*, *Pimelea delicatula*, *Olea præmissa*, *Fraxinus Heerii*, *F. mespilifolia*, *F. abbreviata*, *F. ? myricæfolia*, *F. Ungeri*, *F. Libbeyi*, *Apocynophyllum Scudderi*, *Porana Speirii*, *P. tenuis*, *Myrsine latifolia*, *Bumelia Florissanti*, *Macreightia crassa*, *Andromeda delicatula*, *A. rhomboidalis*, *Aralia dissecta*, *Hedera marginata*, *Weinmannia integrifolia*, *W. obtusifolia*, *Sterculia rigida*, *Tilia populifolia*, *Acer indivisum*, *Sapindus inflexus*, *S. lancifolius*, *Evonymus flexifolius*, *Celastrus Lacœi*, *C. fraxinifolius*, *C. elegans*, *Ilex pseudo-stenophylla*, *I. microphylla*, *I. maculata*, *I. quercifolia*, *I. grandifolia*, *I. knightiæfolia*, *Rhamnus oleæfolius*, *Juglans Florissanti*, *Rhus fraterna*, *R. coriarioides*, *R. cassioides*, *R. Hilliæ*, *R. subrhomboidalis*, *R. vexans*, *R. trifolioides*, *Zanthoxylon spireæfolium*, *Ailanthus longe-petiolata*, *Amelanchier typica*, *Cratægus acerifolia*, *Rosa Hilliæ*, *Amygdalus gracilis*, *Cytisus modestus*, *C. Florissantianus*, *Cercis parvi-*

folia, Podogonium acuminatum, Leguminosites serrulatus, L. species, *Antholithes amœnus, A. improbus, Carpites gemmaceus, C. Milioides.*

(3) General remarks. Table of distribution of the plants of the Green River and White River groups.

(4) Relationship of the local groups indicated by correlation of species. The plants which have heretofore been referred by the author to the Green River group represent two different horizons: Green River Station, Randolph Company, and Alkali Station for one, Florissant, White River, and Elko for a second. The materials obtained at the first are too scant to afford any indication of their reference to any particular stage of the Tertiary; they may represent a lower group than that of the Florissant, but what is said of the relationship of these plants authorizes a contrary conclusion. Considers the flora of Florissant probably synchronous with that of the Oligocene of France.

IV. Miocene flora:

(1) Description of Miocene species from specimens obtained in the so-called Bad Lands of Dakota. The following are new species: *Asplenium tenerum, Equisetum glubosum, Quercus Dentoni, Ficus artocarpoides, Tetranthera præcursoria, Cinchonidium ovale, Viburnum dakotense, V. Dentoni, Aralia acerifolia, Acer gracilescens, Rhus Winchellii, Prunus dakotensis, Cercis truncata.*

(2) Description of Miocene species of California and Oregon. The following species are new: *Betula parce-dentata, Alnus corrallina, A. carpinoides, Quercus Breweri, Ulnus pseudo-americana, Ficus asiminæfolia, Laurus grandis, L. salicifolia, L. californica, Grewia auriculata, Ailanthus ovata, Myrtus oregonensis, Colutea boweniana.*

(3) Contributions to the Miocene flora of Alaska. The following species are new: *Thuites (Chamæcyparis) Alaskensis, Comptonia cuspidata, C. præmissa, Betula Alaskana, Alnus corylifolia, Quercus Dallii.*

(4) Species of plants from the chalk bluffs of California.

(5) Table of distribution of the North American Miocene fossil plants.

(6) Remarks on the species of Miocene plants. The author concludes that as the fossil floras of Carbon and the Bad Lands are related by ten identical species, and those of the Bad Lands and Alaska by thirteen, these three groups apparently represent the same stage of the North American Miocene. The flora of Carbon has only four species identified in that of Alaska, but their lesser degree of affinity may be ascribed to difference in latitude.

LESQUEREUX, LEO.—Contributions to the Fossil Flora of the Western Territories, part III. *Pop. Sci. Monthly*, vol. XXVII, p. 560. August, 1885. New York.

Notice and brief abstract of Professor Lesquereux's vol. VIII of *Rep. Geol. Surv. Terr.*, under F. V. Hayden. 4to series.

MACKAY, A. H.—Organic Siliceous Remains in the Lake Deposits of Nova Scotia. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 236–244. Montreal.

Divides the deposits as follows: First, earthy muds; second, black or brownish slimy muds; third, whitish siliceous muds, consisting nearly entirely of the cell-walls of the diatomaceæ and the spicules of fresh-water sponges, which are found to be present in classes first and second also, although in less comparative abundance. Gives a list of one hundred and four species of diatomaceæ identified from the siliceous material; also gives a list of the species of living sponges whose spicules abound in the deposits.

MARCOU, JULES.—The Taconic System and its Position in Stratigraphic Geology. *Proc. American Academy of Arts and Sciences*, new series, vol. XII, pp. 174–256. 1885. Cambridge.

Many lists of fossils are given. The "Taconic System" comprehends all the strata in which the Primordial faunæ are found. These faunæ are three in number. The Infra-Primordial, including the most ancient fossils of Newfoundland, among which as yet no trilobite has been found with certainty. The Primordial fauna, properly so-called, that of Bohemia and Scandinavia, and which is represented in America by the *Paradoxides* and *Olenellus* beds. The Supra-Primordial fauna, found at Hof, in Bavaria, at Vestfosen, near Christiania, in Norway, and elsewhere in Europe. On Lake Champlain it includes certain colonies of the second fauna of Barrande, and is terminated by the "Potsdam sandstone," including the "Saratoga limestone," with Primordial fossils discovered by Walcott.

MARCOU, J. B.—Progress of North American Invertebrate Palæontology for 1884. *Amer. Nat.*, vol. XIX, pp. 353–360. April, 1885. Philadelphia.

A brief sketch of the palæontologic work done in 1884. A more extended review is published in the report of the Smithsonian Institution for 1884.

MARCOU, J. B.—A Review of the Progress of North American Invertebrate Palæontology for 1884. *Smithsonian Report* for 1884, No. 610, pp. 1–20. (1885. Washington.)

An attempt has been made to give a brief idea of the contents of each work, the new genera and the species described, and the general conclusions of the authors.

MARCOU, J. B.—(Progress of North American Invertebrate Palæontology for 1884.) *Nature*, vol. XXXII, p. 116. 1885. London and New York.

Notice of Mr. Marcou's paper in the *American Naturalist.*

MARCOU, J. B.—(Identification of Fossils and Strata of the Great Sioux Reservation.) The Lignites of the Great Sioux Reservation, a Report on the Region between the Grand and Moreau Rivers, Dakota, by Bailey Willis. *Bull. U. S. Geol. Surv.*, No. 21, p. 11. 1885. Washington.

A stratigraphic list of the fossils collected by Mr. Willis.

MARCOU, J. B.—A List of the Mesozoic and Cenozoic Types in the Collections of the U. S. National Museum. *Proc. U. S. National Museum*, vol. VIII, pp. 290–344. 1885. Washington.

MATTHEW, G. F.—Recent Discoveries in the Saint John Group. *Canadian Rec. Sci.*, vol. I (1884–'85), pp. 136–141. Montreal.

This article also appeared in the *Bull. Nat. Hist. Soc. New Brunswick*, No. IV, pp. 97–102. 1885. Saint John, New Brunswick.

MATTHEW, G. F.—A New Genus of Cambrian Pteropods. *Canadian Rec. Sci.*, vol. I (1884–'85) pp. 149–152, figs. 1–3 on p. 152. Montreal.

Describes from the Saint John group, the new genus *Camerotheca*, with the new species *C. gracilis* as the type. He refers to this genus *Hyolithes danianus* (*Bull. No.* 10 *U. S. Geol. Survey*). In a note the author states that, after seeing the specific description of Eichwald's typical species *H. acutus*, he considers it necessary to place *Camerotheca* as a subgenus of *Hyolithes*.

MATTHEW, G. F.—An Outline of Recent Discoveries in the Saint John Group. With a Letter of Prof. Alpheus Hyatt relative to the Pteropods. *Bull. Nat. Hist. Soc. New Brunswick*, No. IV, pp. 97–102. 1885. Saint John, New Brunswick.

Gives a general sketch of the Saint John group and its fauna. Considers it to more nearly represent the Solva group than the Menevian. (*See* Hyatt, Alpheus.)

MATTHEW, G. F.—On the Probable Occurrence of the Great Welsh Paradoxides, P. Davidis, in America. *Amer. Jour. Sci.*, 3d ser., vol. XXX, pp. 72, 73. July, 1885. New Haven.

The author states that he has received from Mr. J. P. Howley, director of the Geological Survey of Newfoundland, fragments which appear to belong to the species *Paradoxides Davidis*. They occur in a hard black silico-calcareous shale at Highland's Cove, Trinity Bay, Newfoundland, in company with species of *Agnostus*, *A. punctuosus* Ang., *A. lævigatus* Dalm., *A. Acadicus* Hartt (var. *declivis* Matthew). These fossils indicate a new horizon in the Paradoxides beds of America somewhat above that of Braintree, or the known horizons of Newfoundland and New Brunswick. [It may also occur in the Cambrian slate of Saint John, New Brunswick.]

Matthew, G. F.—(On the Probable Occurrence of the Great Welsh *Paradoxides* (*P. davidis*) in America. *Nature*, vol. xxxii, p. 358. 1885. London and New York.

Notice and abstract of Mr. Matthew's paper in the *Amer. Jour. Sci.*

Matthew, G. F.—Note on the Genus Stenotheca. *Geol. Mag.*, new series, Decade III, vol. ii, pp. 425, 426. September, 1885. London.

Remarks on species from the Saint John group of Nova Scotia. The author mentions five species as occurring in the Saint John group, and makes some remarks on their affinities and habitat.

Matthew, G. F.—Notice of a New Genus of Pteropods from the Saint John Group (Cambrian). *Amer. Jour. Sci.*, 3d ser., vol. xxx, pp. 293, 294, figs. 1–3 on p. 294. October, 1885. New Haven.

Describes the new genus *Diplotheca acadica* Hartt, sp. var. *crassa*, *D. Hyattiana*, and *D. Hyattiana* var. *caudata.*

Matthew, G. F.—Illustrations of the Fauna of the Saint John Group continued. On the Conocoryphea, with further remarks on Paradoxides. *Trans. Roy. Soc. Canada*, vol. ii, section iv, 1884, pp. 99–124, pl. i. (1885. Montreal.)

The author gives further descriptions of *Paradoxides acadicus*, fig. i, of the young of the species; also describes *Paradoxides lamellatus* Hartt, figs. 3 and 4. On fig. 5 the author reproduces a pygidium incorrectly figured in connection with his former paper. (*See* fig. 15, pl. x, vol. i, *Trans. Roy. Soc. of Canada.*) The author suggests that the name *Paradoxides Micmac* be applied to the species fig. 8, pl. x, vol. i, *Trans. Roy. Soc. of Canada.* This is probably the specimen figured in "Acadian Geology." The author divides *Conocoryphea* into two groups: *Ctenocephalus* Corda and *Conocoryphea* Corda; gives a detailed description of *Ctenocephalus Matthewi* Hartt sp. (figs. 6–21, pp. 103–111) and its development and growth. The same thing is done for *Conocoryphe Baileyi* Hartt sp. (figs. 22–27, pp. 111–114), and *Conocoryphe elegans* Hartt sp. (figs. 28–34, pp. 115–119). The author also describes the new species *Conocoryphe Walcotti* (figs. 36 and 36*b*, pp. 119, 120). Makes general comparisons and conclusions on pp. 120–123.

[Milne, Edwards H.].—Structure des Trilobites. *Ann. des Sci. Nat.*, Sixième Sér., vol. xii, Art. 3, p. 33, pls. i–iii. 1881. Paris.

A review of C. D. Walcott's Organization of Trilobites. (Not seen.)

Morris, Charles.—The Primary Conditions of Fossilization. *Proc. Acad. Nat., Sci.* Philad., vol. —, pp. 97–101. July, 1885. Philadelphia.

An interesting paper containing some slight discrepancies and with some of the premises of which many people will disagree. The author reaches the conclusion that "fossilization of animal forms was not possible until, after a long period of evolution, the power of secreting hard external coverings was gained. The author says that there can be no question that the trilobite had foes stronger than himself, against whom he found defense only in his chitinous armor," but he says nothing of the necessity of weapons of attack in these supposed foes.

MORRIS, CHARLES.—Attack and Defense as Agents in Animal Evolution. *Proc. Acad. Nat. Sci.*, Philad., vol. —, pp. 385–392. December, 1885. Philadelphia.

Early fossilization is due to the preservation of the dermal skeletons of animals of considerably advanced organization, and those were probably preceded during a long era by soft-bodied forms of low organization. Yet, after the advent of armored animals, it is probable that the seas were still tenanted by numerous soft-bodied forms, mainly swimmers, the progenitors of the many naked ocean swimmers which still exist. Later the tendency is no longer to assume armor, but to throw it off and return toward the unprotected condition. Finally, in the human species, even the covering of hairs is nearly lost, and in external condition the highest form of animal life approaches the lowest. The armored cephalopods have gradually disappeared till only the *Nautilus* remains. The unarmored forms have rapidly increased until they abundantly people the modern seas. The changes described have taken place under the influence of one of the most active agents in evolution, that of the reciprocal influence of attack and defense on animal structure. Thus we seem to perceive four successive ideas emerging into prominence in the development of the animal kingdom. In the primæval epoch it is probable that only soft-bodied animals existed, and the weapons of assault were the tentacle, the thread cell, the sucking disk, and the like unindurated weapons. At a later period armor became generally adopted for defense, and the tooth became the most efficient weapon of attack, till later armor was discarded, and flight or concealment became the main method of escape, and swift pursuit the principle of attack, while claws were added to teeth as assailing weapons. Finally, mentality came into play, intelligence became the most efficient agent both in attack and defense, and a special development of the mind began.

The article is so condensed as to render it difficult to give a brief synopsis of it.

MEYER, OTTO.—The Genealogy and the Age of the Species in the Southern Old-Tertiary. *Amer. Jour. Sci.*, 3d ser., vol. XXIX, pp. 457–468; vol. XXX, pp. 60–72, and 421–435, figs. a–c, on p. 70. June, July, and December, 1885. New Haven.

The author considers that the succession is just the contrary from what has ordinarily been supposed, the Vicksburg being the oldest, and the Claiborne the most recent formation. The article is divided into three parts.

Part I. The genealogical relations of the species. In the first part the author characterizes and partly describes the following new species: *Discoflustrellaria Jacksonensis, Limopsis radiatus, Astarte sulcata*, var. *Jacksonensis, A.* (*Micromeris*) *parva* Lea, var. *Vicksburgensis, Venericardia diversidentata, V. parva* Lea, var. *Jacksonensis, V. inflatior, V. inflatior* var. *Jacksonensis, Cytherea Jacksonensis, Tellina Vicksburgensis* Conrad, var. *robusta, Periploma Claibornensis* Lea, var. *parva, Mactra inornata, Corbula Willistoni, Dentalium subcompressum, D. Leai, D. Danai, Cadulus Jacksonensis, C. Vicksburgensis, Teinostoma subrotunda, T. angularis, T. Verrilli, Natica decipiens, Distortrix Jacksonensis, Fusus Bœttgeri, Turbinella humilior, Fulgur filius, Marginella incurva* Lea, var. *Jacksonensis, Oliva media, Pleurotoma exculpata, Conus protracta, C. Jacksonensis, Actœon annectens.* Gives a table showing the successional relations of the Vicksburg, Jackson, and Claiborne species.

Part II. The age of the Vicksburg and the Jackson beds. This part is mostly made up of bibliographical extracts and the author's interpretation of former writers' works; he describes the new species *Scalpellum Eocenense* from stratum b of the Claibornian. The author's views the relative ages of the formations have already been cited above.

Part III. Reply to criticisms. The author defends his views against the criticisms of E. W. Hilgard, E. A. Smith, and T. H. Aldrich, in the October number of the *Amer. Jour. Sci.*

Meyer, Otto.—(The Genealogy and Age of the Species in the Southern Old Tertiaries.) *Nature*, vol. xxxii, p. 358. 1885. London and New York.

Notice of Dr. Meyer's paper in the *Amer. Jour. Sci.*, parts i and ii.

Meyer, Otto.—The Classification and Palæontology of the U. S. Tertiary Deposits. *Science*, vol. v, No. 125, p. 516. June, 1885. Cambridge.

Mr. Meyer refers people interested in his article to the second part of it in the July number of the *American Journal.*

Meyer, Otto.—The Classification and Palæontology of the U. S. Tertiary Deposits. *Science*, vol. vi, No. 133, pp. 143, 144. August, 1885. Cambridge.

An answer to Mr. Angelo Heilprin's criticism on his work, published in *Science*, July 31, 1885.

Neumayr, M.—J. E. Whiteaves: On the Fossils of Coal-Bearing Deposits of the Queen Charlotte Island, collected by Dr. G. H. Dawson in 1878. *Geological and Natural History Survey of Canada.* Mesozoic Fossils, vol. i, part 3. 1884. Montreal. On the Lower Cretaceous Rocks of British Columbia, *Transactions of the Royal Society of Canada*, Sect. iv, 1882, S. 81. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band ii, pp. 115–117. Stuttgart. (Abstract.)

NEWBERRY, J. S.—Description of some Peculiar Screw-like Fossils from the Chemung Rocks. *Ann. N. Y. Acad. Sci.*, vol. III, June, 1885, No. 7, pp. 217–220, pl. xviii. New York.

Describes the new genus *Spiraxis* and two species under it, *S. major* and *S. Randalli*, from the Chemung group in Northern Pennsylvania and Southern New York. No definite opinion is given as to the affinities of the genus.

NEWBERRY, J. S.—Some Peculiar Screw-like Casts from the Sandstones of the Chemung Group of New York and Pennsylvania. *Trans. N. Y. Acad. Sci.*, vol. III, 1883–'84, pp. 33, 34. 1885. New York.

The new genus *Spiraxis* and species *S. major* and *S. Randalli* fully described and figured in the *Annals*, vol. III, No. 7. The present descriptions were read December 3, 1883.

NEWBERRY, J. S.—(Some Peculiar Screw-like Fossils from the Chemung Rocks of Northern Pennsylvania and Southern New York.) *Pop. Sci. Monthly*, vol. XXVII, p. 719. September, 1885. New York.

A notice and abstract of Professor Newberry's article in the *Annals of the New York Academy of Sciences.*

NICHOLSON, H. A., and ETHERIDGE, ROBERT, Jr.—On the Synonymy, Structure, and Geological Distribution of *Solenoptera compacta*, Billings sp. *Geol. Mag.*, new series, Decade III, vol. II, pp. 529–535, pl. xiii. December, 1885. London.

Describes and discusses the relations, occurrence, and varieties of the fossil mentioned, originally described from the Black River limestone under the *Stromatopora compacta* Billings.

NICHOLSON, H. A., and FOORD, A. H.—On the Genus Fistulipora McCoy, with descriptions of several species. *Annals and Magazine of Natural History*, 5th series, vol. XVI, pp. 496–517, pls. xv–xviii, figs. 1–6, pp. 497, 501, 507, 513, and 514. December, 1885. London.

Describes *Fistulipora utriculus* Rominger, from the Hamilton group at Arkona, Ontario, Canada, and *F. eriensis* Rominger, from the Hamilton group at Canandaigua, Ontario County, New York.

PACKARD, A. S.—Types of Carboniferous Xiphosura new to North America. *Amer. Nat.*, vol. XIX, pp. 291–294. March, 1885. Philadelphia.

From the Carboniferous beds of Pittston, Pa., the author describes a new species, *Eupropis longispina.* From Mazon Creek, Morris, Ill., he describes a new species of *Belinurus* and one of *Cyclus*, two genera new to this continent, and a new genus, *Dipeltis*, which he places among the *Cyclidæ* for the present; the specific names are *Belinurus lacœi*, *Cyclus americanus*, *Dipeltis diplodiscus.* Fuller descriptions, with illustrations and measurements, will be published subsequently.

PACKARD, A. S.—The Syncarida, a Group of Carboniferous Crustacea. *Amer. Nat.*, vol. XIX, pp. 700–703. July 1, 1885. Philadelphia.

Presents the conclusions of a paper read at the last meeting of the National Academy of Sciences. The author considers the *Syncarida* as a suborder, standing near or at the base of the *Thoracostraca*, not far from the *Stomapoda* and *Schizopoda*, and with appendages closely homologous with those of these two groups. In their lack of a carapace and in the well formed dorsal arch of the seven thoracic segments, we are obliged to consider them as an annectant group, pointing to the existence of some extinct group which may have still more closely connected the sessile-eyed and stalk-eyed Crustacea.

[PACKARD, A. S.]—On the Gampsonychidæ, an Undescribed Family of Fossil Schizopod Crustacea. *Amer. Nat.*, vol. XIX, pp. 790–793. August, 1885. Philadelphia.

Abstract of a paper read at the April meeting of the National Academy of Sciences. The study of about a dozen specimens of *Palæocaris typus* Meek and Worthen, has led the author to compare the genus with *Gampsonyx*, and the result has led to the formation of a family or higher group for the two genera, which should properly stand at the base of the *Schizopoda*, while also serving to bridge over the chasm existing beween the thoracostracous suborders *Syncarida* and *Schizopoda*. This group may be called *Gampsonychidæ*. The principal character which separates this group from all other schizopods is the entire absence of a carapace. When we compare the *Gampsonychidæ* with the *Syncaridæ* (*Acanthotelson*) we see that both groups have the same number of body segments and that both lack a carapace; and thus while the *Gampsonychidæ* are the ancestors of living schizopods, the group as a whole probably descended from *Acanthotelson*, which is thus a truly synthetic form, standing in an ancestral relation to all the *Thoracostraca*, while it also suggests that the sessile-eyed and stalk-eyed Crustacea may have had a common parentage.

PACKARD, A. S.—On the Anthracoridæ, a Family of Carboniferous Macrurous Decapod Crustacea, allied to the Eryonidæ. *Amer. Nat.*, vol. XIX, pp. 880, 881. September, 1885. Philadelphia.

Abstract of an article read before the National Academy of Sciences in April, 1885. The author has had opportunity of studying specimens of *Anthrapalæmon gracilis* Meek and Worthen. The newly observed characters are the carapace with its rostrum, showing that the American species in these respects closely resembles the European ones figured by Salter, the founder of the genus. Moreover, specimens show the entire thoracic legs, while the antennæ of both pairs were almost entirely shown. The fact that the first pair of thoracic feet were scarcely larger than the succeeding pairs shows that *Anthrapalæmon* cannot be placed in the *Eryonidæ*, but should form the type of a distinct group of family rank, none of the existing *Macrura* having such small anterior legs. At the same time the Carboniferous *Anthracaridæ* were probably the forerunners or ancestors of the Mesozoic and later *Eryonidæ*. From the nature of the differentiation of the telson in the *Galatheidæ* the author is inclined to believe, from what he has observed from the specimens before him, that the telson of *Anthrapalæmon* is subdivided in nearly the same manner. If so, the genus cannot be referred to the *Eryonidæ*, and should therefore be regarded as the type of a distinct family, which he calls *Anthracaridæ*, and briefly characterizes.

PEACH, B. N.—Ancient Air-breathers. *Nature*, vol. XXXI, pp. 295–298, figs. 1 and 2 on pp. 296 and 297. 1885. London and New York.

A general review of Palæozoic scorpions; cites the genus *Eoscorpius* Meek and Worthen. States that Professor Lindstrom shows that *Palæophoneus nuncius* was a land animal and a true air-breather. Considers that *Gyrichnites*, of the Lower Devonian of Gaspé, may have been animals which supplied food to the ancient scorpions.

PEACH, B. N.—(Notice of.) (A Compendium to our Knowledge of the Ancient Scorpions, *Nature*, January 29, 1885.) *Amer. Nat.*, vol. XIX, p. 706. July, 1885. Philadelphia.

Cites Meek and Worthen's description of *Eoscorpius* in 1866.

PERRY, J. H.—Note on a Fossil Coal Plant found at the Graphite Deposit in Mica Schist, at Worcester, Mass. *Amer. Jour. Sci.*, 3d ser., vol. XXIX, pp. 157, 158. February, 1885. New Haven.

Reports finding two specimens of Lepidodendron referred to *Lepidodendron* (*Sagenaria*) *acuminatum* Goeppert, by Prof. L. Lesquereux, who says that they are the first specimens seen by him from America. Prof. C. H. Hitchcock considered the mica schist of Huronian age.

POHLMAN, JULIUS, and WHITFIELD, R. P.—An American Silurian Scorpion. *Science*, vol. VI, No. 135, pp. 183, 184, fig. on p. 183. September, 1885. Cambridge.

Mr. Pohlman states that the scorpion described by Professor Whitfield on pages 87 and 88 of *Science*, vol. VI, is undoubtedly a young specimen of *Eusarcus scorpionis* (Grote and Pitt; *Bulletin of the Buffalo Society of Natural Sciences*, vol. III, pp. 1, 2), so named by an error, and which will be redescribed as *Eurypterus scorpionis* in the forthcoming vol. V of the society's bulletin. He gives a figure of the youngest specimen in his possession.

In a note Professor Whitfield gives his reasons for not believing the fossil described by him to be the young of that or any other Eurypteroid.

ROGERS, W. B.—A Reprint of Geological Reports and other Papers on the Geology of the Virginias, by the late William B. Rogers, pp. I–XV, and 1–832, with six plates of fossils and maps in pockets. 1884. New York.

Contains, amongst the other papers, a reprint of "On the Age of the

Coal Rocks of Eastern Virginia," from Transactions of the Association of American Geologists and Naturalists, 1840–'42. Contains descriptions of plants with one plate. Also a reprint of "Contributions to the Geology of the Tertiary Formations of Virginia," by W. B. Rogers and H. D. Rogers, from the Transactions of the American Philosophical Society, Philadelphia, 1835 and 1837. Contains descriptions of Miocene and Eocene fossils, with five plates.

[ROGERS, W. B.].—Geology of the Virginias. *Science*, vol. VI, No. 126, pp. 17, 18. July, 1885. Cambridge.

A review of "Reprint of Geological Reports and other Papers on the Geology of the Virginias," by the late William B. Rogers. 1884. New York.

SCUDDER, S. H.—The Geological History of Myriopods and Arachnids. Eighth annual address of the retiring president of the Cambridge Entomological Club. *Psyche*, vol. —, pp. 245–250. January–March, 1885. Cambridge.

A summary of our knowledge of the geologic history of the two groups. The author also gives two tables of the geological distribution of Myriopods and of Arachnids. (*See* Scudder, S. H., in the *Amer. Nat.*, vol. XIX, p. 1210, December, 1885.)

SCUDDER, S. H.—Description of an Articulate of Doubtful Relationship from the Tertiary Beds of Florissant, Colo., *Memoirs of the National Academy of Sciences*, vol. III, pp. 1–6, figs. 1–3 on p. 3 (read at Washington, April 20, 1882), published 1885.

The form is called *Planocephalus* aselloides.* Three figures of it are given on page 3; its relations are carefully discussed, and the author concludes that its place is among the *Thysanura*, between the *Cinura* and the *Symphyla;* that it is of equivalent value to them, and for this new group proposes the name of *Ballostoma.*

SCUDDER, S. H.—New Genera and Species of Fossil Cockroaches from the Older American Rocks. *Proc. Acad. Nat. Sci. Philad.*, vol. —, pp. 34–39. April, 1885. Philadelphia.

Describes the new genus *Promylacris*,† and the species *P. ovale*, and the new genus *Paromylacris*‡ and the species *P. rotundum.* These two genera of *Mylacridæ* are from the Carboniferous deposits of Mazon Creek, Illinois. Of the *Blattinariæ* he describes the following new genera and species from the Triassic beds of Fairplay, Colo.: *Spiloblattina*§ *S. Gardineri*, *S. triassica*, *S. guttata*, *S. marginata*, *Petrablattina*

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* Planocephalus n. g. from *πλανάω, κεφαλή.*

† *πρό, μυλακρίς.*

‡ *παρός, μυλακρίς.*

§ *σπῖλός*, Blattina.

æqua, *P. Meieri*, *Poroblattina*,* *P. arcuata*, *P. Lakesii*, and *Oryctoblattina occidua* from the Carboniferous of Mazon Creek, Illinois.

Scudder, S. H.—New Genera and Species of Fossil Cockroaches. *Annals and Magazine of Natural History*, 5th ser., vol. xv, pp. 408–414. May, 1885. London.

Reprinted from the *Proc. Acad. Nat. Sci. Philadelphia*, vol. —, March 10, 1885, pp. 34–39.

Scudder, S. H.—Notes on Mesozoic Cockroaches. *Proc. Acad. Nat. Sci. Philad.*, vol. —, pp. 105–115. July, 1885. Philadelphia.

These notes are divided into three parts. The first is on *Pterinoblattina*,† a remarkable type of *Palæoblattinà; Blattapluma* Giet is the type of the new genus, and the following new species are described under it: *P. penna*, *P. intermixta; Blattina chrysea* E. Geinitz, *Recania hospes* Germ., and *R. gigas* Weyenb., are also referred to it. The second part is on "Triassic Blattariæ from Colorado." In it two new genera and several species are described: *Neorthroblattina*,‡ *N. albolineata*, *N. Lakesii*, *N. rotundata*, *N. attenuata*, *Scutinoblattina*,§ *S. Brongniarti*, *S. intermedia*, *S. recta*. The third part is "On the genera hitherto proposed for Mesozoic Blattariæ." This is a brief revisionof these genera.

Scudder, S. H.—Notes on Mesozoic Cockroaches. *Annals and Magazine of Natural History*, 5th series, vol. xvi, pp. 54–64. July, 1885. London.

A reprint from the *Proc. Acad. Nat. Sci. Philad.*, 1885, pp. 105–115.

Scudder, S. H.—The Relations of the Palæozoic Insects. *Amer. Nat.*, vol. xix, pp. 876–878. September, 1885. Philadelphia.

Abstract of a paper read by Mr. S. H. Scudder at the April, 1885, meeting of the National Academy of Sciences. The author states that while we may recognize in the Palæozoic rocks insects which were plainly precursors of existing *Heterometabola*, we may yet not call these *Orthoptera*, *Neuroptera*, &c., since *ordinal features were not differentiated;* but all Palæozoic insects belonged to a single order which, enlarging its scope, as outlined by Goldenberg, we may call *Palæodictyoptera;* in other words, the Palæozoic insect was a generalized Hexapod, or more particularly a generalized Heterometabolon. Ordinal differentiation had not begun in Palæozoic times.

We find, then, that the entire change from the generalized hexapod to the ordinarily specialized hexapod was made in the interval between the close of the Palæozoic period and the middle, we may say, of the Mesozoic. These significant changes were ushered in with the dawn of the Mesozoic period, and the Triassic rocks became naturally (together

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[*] πόρος, Blattina. [†] πτέρινος. [‡] νέος, ὄρϑος. [§] σκύτινος.

with the Silurian) the most important, the expectant ground of the student of palæontology.

It would then appear that the geological history of winged insects, so far as we know from present indications, may be summed up in a very few words. Appearing in the Silurian period, insects continued throughout Palæozoic times as a generalized form of *Heterometabola*, which, for convenience, we have called *Palæodictyoptera*, and which had the front wings as well as the hind wings membranous.

On the advent of Mesozoic times a great differentiation took place, and before its middle all the orders, both of *Heterometabola* and *Metabola*, were fully developed in all their essential features as they exist to-day; the more highly organized *Metabola* at first in feeble numbers, but to-day, and even in Tertiary times, as the prevailing types. The *Metabola* have from the first retained the membranous character of the front wings, while in most of the *Heterometabola*, which were more closely and directly connected with Palæozoic types, the front wings were, even in Mesozoic times, more or less completely differentiated from the hind wings as a sort of protection covering to the latter, and these became the principal organs of flight.

SCUDDER, S. H.—(A Contribution to the Geological History of Myriopods and Arachnids, in *Psyche*). *Amer. Nat.*, vol. XIX, pp. 1210, 1211. December, 1885. Philadelphia.

An abstract of Mr. Scudder's article in *Psyche.*

The great *Archipolypoda* resemble the *Diplopoda* in having two pairs of legs on every segment; while in the *Protosygnatha* only a single pair of legs is borne by each segment, and the group thus resembles the *Chilopoda*. For a brief period after leaving the egg, modern diplopods and pauropods have a shorter body than in after life, and the first three segments bear but a single pair of legs. In adult life these first three segments still bear but a single pair of limbs, while all the other segments, both those which exist in the larval state and those which develop afterwards, bear two pairs. The *Chilopoda* have these same anterior pairs of limbs early and permanently developed as organs of manducation, while all other segments have but a single pair. Palæontologic evidence is in favor of the view that the dorsal scutes of *Diplopoda* are compound. The archipolypodous type is the oldest, and there is evidence that some of the Carboniferous forms were amphibious. The group culminated in the Carboniferous, and does not appear to occur later than the Dyas, while, with one doubtful exception, no true diplopod is known to be older than the Oligocene. According to S. H. Scudder, between twenty and thirty species of pre-Tertiary *Arachnida* are now known, and the earlier forms, chiefly of Carboniferous age, belong either to the *Scorpionides* or to the *Anthracomarti*, a group which is not known later than Palæozoic times, the only Mesozoic arachnids yet known being true spiders.

SEELY, H. M.—A new Genus of Chazy Sponges, Strephochetus. *Amer. Jour. Sci.*, 3d ser., vol. XXX, pp. 355–357, figs. 1–3 on p. 356. November, 1885. New Haven.

Describes the new genus *Strephochetus*,* of which *S. oscellatus* is described as the type. It occurs in connection with well recognized Chazy forms, and especially with *Maclurea magna*. It is found in place in the town of Addison, Bridport, &c., in Addison County, Vermont.

SMITH, E. A.—Remarks on a Paper of Dr. Otto Meyer on "Species in the Southern Old Tertiary." *Amer. Jour. Sci.*, 3d ser., vol. XXX, pp. 270–275. October, 1885. New Haven.

Criticises Dr. Otto Meyer's views, corrects his quotations of Sir Charles Lyell, and offers two kinds of evidence of the superposition of the white limestone above the Claiborne sands, (a) evidence from direct superposition, (b) from geographical position.

STEINMANN, GUSTAV.—A. H. Ford: On Three new Species of Monticuliporoid Corals. *Ann. and Mag. Nat. Hist.*, ser. 5, vol. XIII, pp. 338–342, and XII, 1884. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band II, p. 205. Stuttgart. (Abstract.)

UHLIG V.—A. Hyatt: Fossil Cephalopoda in the Museum of Comparative Zoology. *Proceedings of the American Association for the Advancement of Science*, vol. XXXII, August, 1883. 8vo. *Neu. Jahrb. fur Min. Geol. & Pal.*, 1885, Band I, pp. 324–329. Stuttgart. (Abtract.)

WACHSMUTH, C., and BARRIS, W. H.—Descriptions of new Crinoids and Blastoids from the Hamilton Group of Iowa and Michigan, pp. 1–29, pls. i, ii, figs. 1–3 on pp. 9 and 13.

This is a collection of several articles. The first is taken from the *Proceedings Davenport Academy of Natural Sciences*, vol. IV, p. 76, as are also the two plates, and probably the articles also; but I have no means at present of ascertaining that fact. The various articles are as follows:

(1) On a new Genus and Species of Blastoids, with Observations upon the Structure of the Basal Plates in Codaster and Pentremites. By Charles Wachsmuth. [This article, which appeared in the *Geological Report of Illinois*, vol. VII, p. 346, has been revised by the author.]

(2) Descriptions of some new Blastoids from the Hamilton Group. By W. H. Barris. [This article also appeared in the *Geological Report of Illinois*, vol VII, p. 357.]

(3) Description of a new Crinoid from the Hamilton Group of Michigan. By Charles Wachsmuth. Describes *Megistocrinus concavus* as a new species.

(4) Descriptions of some new Crinoids from the Hamilton Group.

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* *στρέφω*, I twine; *δχετὸς*, canal.

By W. H. Barris. (Presented before the Davenport Academy of Sciences, 1883.) Describes the new variety *Megistocrinus nodosus*, var. *multide-coratus* and *Dolatocrinus triadactylus*.

(5) *Stereocrinus* Barris. (Revised.) By W. H. Barris.

WACHSMUTH, CHARLES, and SPRINGER, FRANK.—Revision of the Palæocrinoidea. Part iii. Discussion of the Classification and Relations of the Brachiate Crinoids, and Conclusion of the Generic Descriptions. *Proc. Acad. Nat. Sci. Philad.*, vol. —, pp. 225–364, pls. iv–ix. December, 1885. Philadelphia.

An author's edition with a distinct pagination has also been published. This contains only the first section of part iii. The second section, containing the *Articulata* and *Inadunata*, has been referred by the Philadelphia Academy to their Proceedings of 1886. The authors give an elaborate discussion of the structure of the *Palæocrinoidea*, which they divide into three groups. The name "*Camarata*" is proposed for all *Palæocrinoidea*, in which the lower arm plates are incorporated into the calyx by interradial plates, and in which all the component parts of the test, dorsally and ventrally, are solidly connected by suture. Under the name "*Articulata*" they include those families in which the plates of the test are united by loose ligaments or muscles, and in which they are somewhat movable. The name "*Inadunata*" is proposed for all *Palæocrinoidea* in which the arms are free above the first radials and which have five single interradials located ventrally. The preliminary discussion is subdivided under the following heads:

(1) The plates of the abactinal system. A. The basals and underbasals. B. The radial and arm plates. C. The interradial, interaxillary, and interbrachial plates. From the observations under this head the authors draw the following conclusions, viz: (1) Interradials are represented in all groups of the *Palæocrinoidea.* They were developed in the larva, attained at once large proportions, and persisted through life or were resorbed on approaching maturity. (2) They extend invariably to the proximals, or even cover them completely. (3) They are more extravagantly developed in the earlier groups, not always in number, but by extending over comparatively larger space. (4) In all groups in which the arms are free from the first radials they are represented by only five single plates, and these are located ventrally. Groups with two or more radials have two at least, and the number increases in proportion to the increase of the radials, by means of which the lower series attain gradually a dorsal position. D. The anal plates and anal tube.

(2) The plates of the actinal system. A. The summit plates. The authors think that the orals, if these are developed in *Palæocrinoidea*, which they think is the case, can only be represented by the central plate. A resorption of the summit plates may have taken place in the

later *Inadunata;* throughout the *Camarata* they persisted through life. B. The ventral perisome.

(3) The relations of the *Palæocrinoidea* to the *Neocrinoidea.* Give a definition of the two groups.

(4) Classification. The following classification is adopted, viz:

PHYLUM ECHINODERMATA.

Class *Pelmatozoa.*

Subclass I. Anthodiata.
  Order I. Cystidea, &c.
  Order II. Blastoidea.

Subclass II. Crinoidea (Brachiata).
  Order III. Palæocrinoidea.
  Order IV. Neocrinoidea.

Definitions of the class *Pelmatozoa* and subclass *Crinoidea* are given.

(5) The subdivisions of the *Palæocrinoidea.* These have already been mentioned.

The suborder *Camarata* is divided into ten families, which are defined; they are as follows: (A) *Reteocrinidæ,* (B) *Rhodocrinidæ,* (C) *Glyptasteridæ,* (D) *Melocrinidæ,* (E) *Actinocrinidæ,* (F) *Platycrinidæ,* (G) *Hexacrinidæ,* (H) *Acrocrinidæ,* (I) *Barrandeocrinidæ,* (J) *Eucalyptocrinidæ.* Under the first family, *Reteocrinidæ,* the new genus *Canistrocrinus*[*] is described. Under the second family, *Rhodocrinidæ,* the new genus *Rhaphanocrinus*[†] is described. Under the third family, *Glyptasteridæ,* the new genus *Ptychocrinus*[‡] is described.

The work contains descriptions of the genera that were not considered in parts i and ii, and the results of the authors' further studies in their bearing on the genera heretofore discussed. The figures have been very well drawn by M. Orestes St. John.

WALCOTT, CHARLES D.—Palæontology of the Eureka District. *Pop. Sci. Monthly,* vol. XXVII, p. 134. November, 1885. New York.

Notice and very brief abstract of Mr. Walcott's Monograph, *U. S. Geol. Survey,* vol. VIII.

WALCOTT, CHARLES D.—Description of the [Deer Creek, Arizona] Coal-field. (Letter from the Secretary of the Interior, transmitting, in compliance with law, letter of the Commissioner of Indian Affairs, with report upon the coal on the White Mountain Reservation in Arizona. Senate Ex. Doc., No. 20, Forty-eighth Congress, second session, Appendix I, pp. 5–7. 1885. Washington.)

Gives a list of the fossils collected from the Carboniferous and Devonian limestones. Refers the coal-beds to the Cretaceous, and gives the genera of plants found in them, as identified by Mr. L. F. Ward.

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[*] *Κάνιστρον,* a willow basket; *κρίνον,* a lily.

[†] *Ῥάφανος,* a radish; *κρίνον,* a lily.

[‡] *Πτύξ,* a fold; *κρίνον,* a lily.

WALCOTT, CHARLES D.—Palæontologic Notes. *Amer. Journ. Sci.*, 3d ser., vol. XXIX, pp. 114–117, pl. on p. 116. February, 1885. New Haven.

In this paper Mr. Walcott publishes a list of the species he found in the Hartt collection from the Saint John group of New Brunswick, at Cornell University. He proposes and defines a new genus of the *Obolidæ*, *Linnarssonia* n. g., Walcott, 1885. Illustrations accompany the description of this new genus; figs. 1 and 2 are given as those of *Obolella chromatica*, and credited to Mr. Billings. The artist, in preparing the figures, copied, by mistake, those of *Obolella crassa* Ford.

WALCOTT, CHARLES D.—Palæozoic Notes; new Genus of Cambrian Trilobites, *Mesonacis*. *Amer. Journ. Sci.*, vol. XXIX, pp. 328–330, figs. 1 and 2 on p. 329. April, 1885. New Haven.

Describes the new genus *Mesonacis* from the Middle Cambrian, at Parker's quarry, Georgia, Vt., and substitutes the name *Bailiella* for the subgenus *Salteria*, proposed by him in *Bull.* No. 10, *U. S. Geol. Survey*. 1884. Washington.

WALCOTT, CHARLES D.—Description of *Mesonacis*, a new Genus of Cambrian Trilobite. *Amer. Nat.*, vol. XIX, p. 707. July, 1885. Philadelphia.

(Notice. *See* Walcott, Charles D. *Amer. Jour. Sci.*, April, 1885.)

WALCOTT, CHARLES D.—Palæozoic Notes; new Genus of Cambrian Trilobites, *Mesonacis*. *Nature*, vol. XXXII, p. 68. 1885. London and New York.

Notice of Mr. Walcott's paper in the *Amer. Journ. Sci.*

WALCOTT, CHARLES D.—Note on some Palæozoic *Pterpods*. *Amer. Journ. Sci.*, 3d ser., vol. XXX, pp. 17–21, figs. 1–6 on p. 20. July, 1885. New Haven.

Describes the new genus *Matthevia*, of which *M. variabilis* is described as the type from Cambrian limestone resting on Potsdam sandstone, 1 mile northwest of Saratoga Springs, N. Y. Records some additional characters of *Hyolithes* (*Camarotheca*) *Emmonsi* Ford.

The characters of *Matthevia* differ so much from all described forms of *Pteropoda* that the author proposes the new family *Matthevidæ* to receive it.

WALCOTT, CHARLES D.—Note on some Palæozoic *Pteropods*. *Nature*, vol. XXXII, p. 358. 1885. London and New York.

Notice and abstract of Mr. Walcott's paper in the *Amer. Journ. Sci.*

WARD, L. F.—The Fossil Flora of the Globe. *The Botanical Gazette*, vol. IX, pp. 169–174. November, 1884. Indianapolis.

Abstract prepared by the author of a paper read before the Amer. Assoc. Adv. Sci. 1884. Philadelphia.

Historical view, pp. 169, 170; Geological view, pp. 170, 171; Botanical view, pp. 171–174, and a table showing the "Number of Species of each of the Principal Types of Vegetation that have been found Fossil in each Geological Formation; also, the number existing at the present time, as nearly as it is possible to ascertain, together with the percentage that each type forms of the total flora of each formation," pp. 172, 173.

WARD, L. F.—A Glance at the History of our Knowledge of Fossil Plants. *Science*, vol. V, pp. 93–95. January, 1885. Cambridge.

WARD, L. F.—Chronology of the Fossil Flora. *Pop. Sci. Monthly*, vol. XXVI, p. 574. February, 1885. New York.

A brief abstract of Mr. Ward's review of what is known of the fossil flora of the globe before the Amer. Assoc. Adv. Sci.

WARD, L. F.—Historical View of the Fossil Flora of the Globe. *Proc. Amer. Assoc. Adv. Sci.*, vol. XXXIII, part ii, pp. 493–495. 1885. Salem.

Abstract. Says that the first attempt to place vegetable palæontology on the footing of a systematic science was made by the Rev. Henry Steinhaver, of Bethlehem, Pa., in a paper read before the Amer. Phil. Soc., and published in its "Proceedings" for the year 1818.

WARD, L. F.—Geological View of the Fossil Flora of the Globe. *Proc. Amer. Assoc. Adv. Sci.*, vol. XXXIII, part ii, pp. 495, 496. 1885. Salem.

(Abstract. Gives the number of species occurring in the different formations.)

WARD, L. F.—Botanical View of the Fossil Flora of the Globe. *Proc. Amer. Assoc. Adv. Sci.*, vol. XXXIII, part ii, pp. 496, 497. 1885. Salem.

Abstract. Gives an account of the first appearance of types of the age of the maximum relative predominance of each type, and of the probable true period of origin and of maximum absolute development of each type.

WARD, L. F.—Evolution in the Vegetable Kingdom. *Amer. Nat.*, vol. XIX, pp. 637–644 and pp. 745–753. July and August, 1885. Philadelphia.

An inquiry as to what vegetable palæontology has to present in favor of evolution in plants. The subject is considered under three somewhat distinct points of view, the historical, the geological, and the botanical. Gives a diagram (p. 749) representing graphically the development of plant life through the successive geologic ages. Gives a diagram showing the progress of each of the leading types of plant life in the different geologic ages (p. 752).

WARD, L. F.—Evolution in the Vegetable Kingdom. *Nature*, vol. XXXII, p. 568. 1885. London and New York.

Notice of Mr. Ward's paper in the *American Naturalist*.

WARD, L. F.—Fontaine's Older Mesozoic Flora of Virginia. *Science*, vol. v, No. 113, pp. 280, 281. April, 1885. Cambridge.

A review of "Contributions to the Knowledge of the Older Mesozoic Flora of Virginia, by William Morris Fontaine. Washington, 1883. 12–144 pp., 54 pls. Monographs of the U. S. Geological Survey, No. VI." The reviewer, while differing slightly from Mr. Fontaine's analysis of the facts, agrees with him in correlating the Richmond coal-fields with the Rhætic of Europe. The reviewer further states that the "seven Jurassic species are mostly from the Lias, or Lower Oolite, which, while not negativing the Rhætic character of the Virginia beds, does seem, when coupled with the rest of the evidence, to negative their Triassic character." From this remark it would seem that the reviewer considers the Rhætic as of Jurassic rather than Triassic age, a conclusion he is hardly justified in assuming.

WARD, L. F.—Lesquereux's Cretaceous and Tertiary Flora. *Science*, vol. v, No. 116, pp. 348, 349. April, 1885. Cambridge.

A review of "Contributions to the Fossil Flora of the Western Territories. Part iii. The Cretaceous and Tertiary Floras, by Leo. Lesquereux. *Rep. U. S. Geol. Survey Terr.* F. V. Hayden, U. S. Geologist, in charge. Vol. VIII, pp. 12, 238, pls. 59. 4to." 1884. *Government.* Washington.

WHITE, C. A.—The Application of Biology to Geological History; a presidental address delivered at the fifth anniversary meeting of the Biological Society of Washington, January 24, 1885. *Proc. Biol. Soc. Washington*, vol. III, pp. 1–20. 1885. Washington.

Concludes that the field geologist and palæontologist must work in concert. Indeed, the field geologist who ignores the use of fossils, as some have affected to do, is sure to burden science with the results of worthless work, and the palæontologist who does not go to the field and study there the formations from which his fossils have been obtained is sure to produce results of work which will be worthy of the condemnation of both geologists and biologists.

WHITE, C. A.—Notes on the Jurassic Strata of North America. *Amer. Journ. Sci.*, 3d ser., vol. XXIX, pp. 228–232. March, 1885. New Haven.

A criticism of Mr. J. F. Whiteaves's views as expressed in "Mesozoic Fossils, vol. I, part iii, *Geol. Survey, Canada*, 1884." The author criticises the identification of nine species of fossils from the Cretaceous strata of British Columbia with fossils considered Jurassic in the United States, and considers the identity of the beds containing them as in no measure proved.

WHITE, C. A.—Notes on the Jurassic Strata of North America. *Nature*, vol. XXXI, p. 522. 1885. London and New York.

(Notice and abstract of Dr. White's article in the *Amer. Journ. Science.*)

WHITE, C. A.—The Genus Pyrgulifera, Meek, and its Associates and Congeners. *Amer. Journ. Sci.*, 3d ser., vol. XXIX, pp. 277–280. April, 1885. New Haven.

Calls attention to the probable identity of the genus *Pyrgulifera* of the Bear River group of North America, the fresh-water Upper Cretaceous of Hungary, and the living shells in Lake Tanganyika. Dr. Leopold Tausch considers that he has found the type species, *P. humerora*, in Hungary. This wide extensive range of fresh or brackish water forms, both in time and space, is very difficult to understand and explain, and has also an extreme interest in relation to the assumed equivalency of formations which bear similar faunas.

WHITE, C. A.—(The Genus Pyrgulifera, Meek, and its Associates and Congeners.) *Nature*, vol. XXXII, p. 68. 1885. London and New York.

Notice and abstract of Dr. White's paper in the *Amer. Journ. Science.*

WHITE, C. A.—On the Mesozoic and Cenozoic Palæontology of California. *Bull. U. S. Geol. Survey*, No. 15, pp. 1–33. 1885. Washington.

The author considers that the Chico-Tejon groups are an unbroken series of strata, and together represent the closing epoch of the Cretaceous and the opening or Eocene epoch of the Tertiary. The unbroken continuity of the series is best illustrated near New Idria, Fresno County; still, there is there, near the middle, a recognizable change in the aspect of the strata, so that in appearance, and to some extent in the character, of the stratification the upper half differs from the lower half.

In the Shasta group Dr. White considers the Knoxville beds as older than the Horsetown beds. The Cretaceous of British Columbia and Alaska he considers as probably the equivalent of the Knoxville beds. This conclusion is based on the occurrence of *Aucella*. The author considers *Aucella erringtonii* and *A. piochii* Gabb as identical, and as varieties of *Aucella concentrica* Fischer, and on this account considers the so-called Jurassic auriferous slate as of the same age as the Knoxville beds of the Shasta group, and considers the existence of the Jurassic in California as very doubtful. The fauna of the Knoxville beds of the Shasta group extends from Alaska southward at least as far as Central California. Some fossils from Southern Mexico apparently come from strata of the same age. No rocks of that age are known to exist to the eastward of the probable site of that belt; and, finally, the Jurassic fauna of the strata which lie to the eastward of the assumed site of the belt is entirely different from that of the Jurassic strata to the westward of it. The author throws out the Martinez group and considers that there is an unbroken stratigraphical and faunal continuity from the Cretaceous to the Tertiary in the Chico-Tejon series. The Shasta group is divided into two divisions, the Knoxville beds and the Horsetown. The latter probably represents the Gault and the former the Lower Neocomian, and there is probably a hiatus between these two divisions. The Knoxville beds are regarded as having been synchronously deposited with the *Aucella*-bearing strata which have been found at various points along the northwest coast of North America, and also as homotaxially equivalent with those which in Northern Europe and Asia bear the same species of *Aucella*.

No species of fossils yet found in the California Cretaceous rocks have been satisfactorily identified with any which occur in strata to the eastward of the Sierra Nevada. The reasons for this view are given in detail in the form of remarks on each specific identification.

This difference in fauna is believed to have been due to the presence of a comparatively narrow but long continental belt which existed in the region which now comprises that of the Pacific coast, continuing from a time at least as early as the earliest epoch of the Cretaceous period.

WHITE, C. A.—On Marine Eocene, Fresh-water Eocene, and other Fossil Mollusca of Western North America. *Bull. U. S. Geol. Survey*, No. 18, pp. 1–26, pls. i–iii, figs. 1–3 on p. 19. 1885. Washington.

This article is divided into several parts, as follows:

(1) The occurrence of *Cardita planicosta* Lamarck in Western Oregon.

(2) Fossil mollusca from the John Day group in Eastern Oregon. These fossils not only all belong to the types which are now living in or near the same region where the fossil forms are found, but a part of the latter are so nearly like the species that the author has not thought it advisable to separate them. The species are all different from any that have been hitherto known in a fossil's condition. The new species, *Unio condoni*, is described, and the description of *Helix* (*Monodon*) *dallii* is given from Dr. R. E. C. Stearns's manuscript.

(3) Supplementary notes on the non-marine fossil mollusca of North America. Some additions and corrections for the illustrations on page 19 are made to the above work.

WHITE, C. A.—On new Cretaceous Fossils from California. *Bull. U. S. Geological Survey*, No. 22, pp. 1–25, pls. i–v. 1885. Washington.

The author regards the Todos Santos Bay locality, upon palæontologic grounds, as equivalent with the Wallala beds, which Dr. Becker considers similar to the Chico group. Dr. White thinks they probably occupy a position between the Chico and Shasta groups. At Wallala, Mendocino County, Dr. Becker found the strata several thousand feet thick, resting upon a metamorphic series which he believes to be equivalent with the Knoxville beds of the Shasta group, but he was unable to discover any contact with the strata above them. The character of the fossils seems to indicate for them the age of the Middle Cretaceous; and in some respects they remind one of the Gosau formation of Europe. The author describes the new genus *Coralliochama;* with *C. orcutti* as its type, he places it among the *Chamidæ.* The following new species are also described: *Trochus* (*Oxystele*) *euryostomus*, *Nerita*——?, *Cerithium, Pillingi*, *C. totium-sanctorum*, *Solarium wallalense.*

WHITEAVES, J. F.—Report on the Invertebrata of the Laramie and Cretaceous Rocks of the Vicinity of the Bow and Belly Rivers and Adjacent Localities in the Northwest Territory. *Geol. and Nat. Hist. Surv. Canada*, A. R. C. Selwyn, director. Contributions to Canadian Palæontology, vol. I, part i, pp. 1–89, pls. i–xi. 1885. Montreal.

From the Laramie of the Willow Creek series the author describes *Unio Albertensis.* From the Saint Mary's River series and lower portion of the Laramie generally he describes the following new species: *Anomia perstrigosa*, *Corbicula obliqua*, *Corbula perangulata*, *Panopœa simulatrix*, *P. curta*, *Acella*——?, *Physa Copei*, var. *Canadensis*, *Acroloxus radiatulus*, *Patula angulifera*, *P. obtusata*, *Anchistoma parvulum*, *Valvata filosa*, *V. bicincta.* No new species are described from the Laramie of the Souris River district.

The following new forms are described from the "Fox Hills" and "Fort Pierre" groups of the Upper Cretaceous: *Gervillia recta*, var. *borealis*, *Modiola* (*Brachydontes*) *dichotoma*, *Cyprina ovata*, var. *alta*, *Protocardia borealis*, *Panopœa subovalis*, *Scaphites subglobosus.*

The Belly River series, which the author thinks it would be impracticable on purely palæontological evidence to separate from the Laramie and more especially from the "Judith River group." From the Pale or upper portion of the series, two new species are described, *Crenella* (?) *parvula*, *Unio consuetus;* from the lower or yellowish and banded portion of the series the following new species are described: *Unio supragibbosus*, *Rhytophorus* (?) *glaber*, *Planorbis paucivolvis*, *Hydrobia subcylindracea.* A number of fossils are mentioned as occurring in the "Lower Dark Shales" of Dr. Dawson's report, but no more new species are described. A number of fossils are also mentioned from uncertain geological horizons.

WHITEAVES, J. F.—Notes on the possible Age of some of the Mesozoic Rocks of the Queen Charlotte Islands and British Columbia. *Amer. Journ. Sci.*, 3d ser., vol. XXIX, pp. 444–449. June, 1885. New Haven.

The author reviews some previously expressed opinions on the age of the Mesozoic rocks mentioned, as well as on the age of the Aucella-bearing rocks of Europe, and criticises Dr. White's remarks on his identification of nine species with Jurassic fossils of the Territories.

WHITEAVES, J. F.—Notes on the possible Age of some of the Mesozoic Rocks of the Queen Charlotte Islands and British Columbia. *Nature*, vol. XXXII, p. 358. 1885. London and New York.

(Notice of Mr. Whiteaves's paper in the *Amer. Jour. Science.*)

WHITEAVES, J. F.—Description of a new Species of Ammonite from the Cretaceous Rocks of Fort Saint John, on the Peace River. *Trans. Roy. Soc. Canada*, vol. II, section iv, 1884, pp. 239, 240. 1885. Montreal. (Read May 23, 1884.)

The specimens were collected mostly from large concretionary nodules in shales which, from their position, may possibly represent the Fort Benton group of the Upper Missouri Cretaceous. The generic position of the species is doubtful, but the author proposes for it the name of *Buchiceras* (?) *cornutum*, although he says it is quite as likely to be an *Acanthoceras* or an *Hoplites.*

WHITEAVES, J. F.—Note on a Decapod Crustacean from the Upper Cretaceous of Highwood River, Alberta, North West Terr. *Trans. Roy. Soc. Canada*, vol. II, section iv, pp. 237, 238. 1885. Montreal. (Read May 21, 1884.)

The specimen described is too imperfect to admit of the determination of its exact generic position, but the author proposes for the present to designate it as *Hoploparia* (?) *Canadensis.*

WHITFIELD, R. P.—An American Silurian Scorpion. *Science*, vol. VI, No. 130, pp. 87, 88, fig. on p. 88. July, 1885. Cambridge.

Describes and names *Palæophonus Osborni*, from the waterlime beds of the Lower Helderberg group, at Waterville, Oneida County, New York. The author expresses doubt as to its being a land animal.

WHITFIELD, R. P.—On a Fossil Scorpion from the Silurian Rocks of America. *Bull. Am. Mus. Nat. Hist.*, October 10, 1885, vol. I, No. 6, pp. 181–190, pls. xix and xx, figs. 1, 2 on pp. 188, 189. New York.

Proposes the new genus *Proscorpius,* and describes as its type *P. Osborni* from the waterlime beds of the Lower Helderberg at Waterville, N. Y. The author places this species in the following manner:

Order Scorpionidea, Lund.
Suborder Anthracoscorpii, T. & L.
Family Eoscorpionidæ, Scudder.
Subfamily Proscorpionini, Scudder.
Genus Proscorpius, Whitfield.

The species was previously named *Palæophonus Osborni* by him. (*See Science*, vol. VI, No. 130, p. 88.)

WHITFIELD, R. P.—Notice of a new Cephalopod from the Niagara Rocks of Indiana. *Bull. Amer. Mus. Nat. Hist.*, October 10, 1885, vol. I, No. 6, pp. 191, 192, pl. xxi. New York.

Describes *Lituites Bickmoreanus* from the Dolomite limestone of the Niagara group at Wabash City, Ind.

WHITFIELD, R. P.—Notice of a very large Species of Homalonotus from the Oriskany Sandstone Formation. *Bull. Amer. Mus. Nat. Hist.*, October 10, 1885, vol. I, No. 6, pp. 193–195, pl. xxii. October. New York.

Describes *Homalonotus major* from the Upper Oriskany? at Cranberry Dam, 5th Binnewater, Ulster County, New York, collected by Louis Bevier. The "5th Binnewater" the author supposes to refer to a dam of the Delaware and Hudson Canal Company's privilege on the Binnewater Creek.

WILLIAMS, H. S.—C. A. White: A Review of the Fossils Ostreidæ of North America, and a comparison of the Fossil with the Living Forms. With appendices by Prof. A. Heilprin and Mr. J. A. Ryder. S. 273–430, Taf. xxxiv–lxxxii. *Neu. Jahr. Min. Geol. and Pal.*, Jahr. 1885, Band II, p. 292. Stuttgart. (Abstract.)

WILLIAMS, H. S.—Geographical and Physical Conditions as modifying Fossil Faunas. *Proc. Amer. Assoc. Adv. Sci.*, vol. XXXIII, part ii, pp. 422, 423. 1885. Salem.

Abstract. The author says that "many other details might be mentioned, all pointing to the one conclusion that, in passing over geographical areas of sedimentary deposits of even a few hundred miles in extent, especially when the direction is vertical to the probable coast line of the period, the effects of those changed conditions recorded in the different nature and structure of the deposits, and of other conditions only recorded in the fossils themselves, which were probably differences of temperature and ocean currents, must be borne in mind in classifying the deposits."

WILLIAMS, H. S.—Notice of a new Limuloid Crustacean from the Devonian. *Amer. Journ. Sci.*, 3d ser., vol. XXX, pp. 45–49, figs. 1–3a, p. 48. July, 1885. New Haven.

The specimen was found in the bluish sandstone (which in places is a fine pebbly conglomerate) at Le Boeuf, called the "third oil sand," by Mr. I. C. White in the Report Q of the *Second Geol. Survey of Pennsylvania* (p. 239), and regarded by him as the equivalent of the third oil sand of the Venango oil district of that State. In the same stratum and above it are typical Chemung fossils. The author describes it under the name of *Prestwichia Eriensis*, and gives three figures of it on page 48.

WILLIAMS, H. S.—Notice of a new Limuloid Crustacean from the Devonian Formations of Erie County, Pennsylvania. *Nature*, vol. XXXII, p. 350. 1885. London and New York.

Notice and abstract of Mr. Williams's paper in the *American Journal of Science.*

WINCHELL, A.—Notices of N. H. Winchell on Lingula and Paradoxides from the Red Quartzites of Minnesota. *Amer. Journ. Sci.*, 3d ser., vol. XXX, pp. 316, 317. October, 1885. New Haven.

Notice of the exhibition, by N. H. Winchell, at the meeting of the Amer. Assoc. Adv. Sci., at Ann Arbor, of a large slab from the "Pipestone quarries," covered with small shells named by him *Lingula.* From the same quarries a form, regarded as an imperfect *Paradoxides*, was also exhibited. (*See* Winchell, N. H.)

WINCHELL, A.—On Cœnostroma and Idiostroma and the comprehensive character of Stromatoporoids. *Amer. Journ. Sci.*, 3d ser., vol. XXX, p. 317. October, 1885. New Haven.

An abstract of a paper read before the meeting of the Amer. Assoc. Adv. Sci., at Ann Arbor, by A. Winchell. The author concludes that it is vain to seek to place Stromatoporoids within the bounds of any recognized class type.

WINCHELL, N. H.—Fossils from the Red Quartzite at Pipestone. *Geol. and Nat. Hist. Surv. Minn.*, 13th Ann. Rep., for 1884, pp. 65–72, pl. i. 1885. Saint Paul.

Describes and illustrates two new doubtful fossils, *Lingula calumet* and *Paradoxides barberi.* Also contains two letters on these dubious forms, one by Prof. J. D. Dana and the other by Mr. S. W. Ford.

WINWOOD, H. H.—Geological Age of the Rocky Mountains. *Geol. Mag.*, new ser., Decade III, vol. II, p. 240. May, 1885. London.

Reports finding a Menevian fauna with abundant remains of *Paradoxides*, *Conocoryphe*, and other allied forms north of the forty-ninth parallel, and between the one hundred and sixteenth and one hundred and seventeenth parallels of longitude, near Kicking Horse Pass on the Canadian Pacific Railway.

WOODWARD, HENRY.—Notice of a new Limuloid Crustacean from the Devonian. By Henry Shaler Williams, of Cornell University. *Geol. Mag.*, new ser., Decade III, vol. II, pp. 427–429. September, 1885. London.

An abstract of H. S. Williams's article in the *Amer. Journ. Sci.*, vol. XXX, p. 45. July, 1885. New Haven. States that Mr. Williams's specimen, although of great interest, is too obscure to permit us to draw any positive conclusions from it, save the fact of the important discovery of a Limuloid Crustacean in rocks of Devonian age in Pennsylvania. A still earlier Limuloid form has, however, been met with in the Upper Silurian of Lesmahagow, Lanarkshire, and described by Henry Woodward under the name of *Neolimulus falcatus.* (*See Geol. Mag.*, vol. V, pp. 1–3, pl. i, fig. 1, 1868.)

WRIGHT, B. H.—Notes on the Geology of Yates County, New York. Thirty-fifth Rep. *N. Y. State Mus. Nat. Hist.*, pp. 195–206, pls. XV and XVa. 1884. Albany.

Copies the figures and descriptions of Dawson in the *Quarterly Journal Geol. Soc.* of London for May, 1881, of the following fossils: *Equisetides Wrightiana*, *Cyclostigma affine*, *Asteropteris noveboracensis*, and gives short lists of fossils from various localities.

ZOOLOGY.

By Prof. THEODORE GILL.

INTRODUCTION.

The laborers in the various fields of Zoology have prosecuted investigations in the year 1885 with undiminished ardor, and scarcely any department has been neglected. The tendency manifested for some years towards a special study of embryology and of animals from an embryological standpoint, has been continued. Systematic zoology, on the other hand, has at least maintained its course during the period, and some most valuable works have appeared. Among such may be especially mentioned the first two of the comtemplated three volumes of a catalogue of the Lacertilian reptiles in the British Museum, by Dr. George Edward Boulenger. A number of works on extinct animals, in which groups have been systematically considered, have been also published. Doubtless the most important and interesting of these for the American zoologist are (1) the enormous volume by Prof. E. D. Cope on The Vertebrata of the Tertiary Formations of the West (Part I), and (2) Prof. O. C. Marsh's beautifully illustrated and printed "Dinocerata, a monograph of an extinct order of gigantic mammals." Both of these volumes do indeed purport on their title pages to have been printed in previous years, Cope's work bearing the imprint of 1883 and Marsh's that of 1884, but they were not really published or accessible to the public till early in 1885.

As in the previous reports, the language of the original from which the abstract is compiled is generally followed as closely as the case will permit. It has, however, been found necessary to limit the abstract to the illustration of the prominent idea underlying the original memoir, and pass by the proofs and collateral arguments. At the same time it has been often attempted to bring the new discovery into relation with the previous status of information respecting the group under consideration. As to the special discoveries recorded, they have been generally selected (1) on account of the modifications the forms considered may force on the system; or (2) for the reason that they are or have been deemed to be of high taxonomic importance; or (3) because the animals *per se* are of general interest; or, finally (4), because they are of special interest to the American naturalist. Of course zoologists cultivating limited fields of research will find in omissions cause for censure, and may urge that discoveries of inferior importance have been noticed to the exclusion of those better entitled to it. It is freely admitted that this charge may even be justly made; but the limits assigned to the record have been much exceeded, and the recorder has studied the needs of the many rather than of the few. The summary is intended, not for the advanced scientific student, but for those who entertain a general interest in zoology or some of the better-known classes.

A partial bibliography of noteworthy memoirs and works relating to different classes of animals is supplied in the present article, and will, it is hoped, prove to be of use to those to whom the voluminous bibliographies and records of progress in science are inaccessible. It has been a difficult matter to select the titles which might be most advantageously introduced in a limited report like the present. Articles of a general interest or of special importance as contributing to throw light on the affinities of certain groups have been given the first place. Necessarily many very important papers have not been referred to and very few descriptive of species have been admitted and only when unusual interest attaches to the new species or the groups which they enlarge

The compiler desires to make special acknowledgment for most material assistance to the *Zoologischer Anzeiger* of Professor Carus, and to the *Journal of the Royal Microscopical Society*, whose abstracts of investigations have been freely drawn upon in the preparation of those for the present report.

SYNOPSIS OF ARRANGEMENT.

GENERAL ZOOLOGY.
I. PROTOZOANS. Rhizopods; Sporozoans; Infusorians.
II. PORIFERS. Sponges.
III. CŒLENTERATES. Polyps; Acalephs.
IV. ECHINODERMS. Crinoids; Asterioids; Echinoids; Holothurians.
V. WORMS. Rotifers; Platyhelminths; Nematelminths; Annelids.
VI. ARTHROPODS. Merostomes; Crustaceans; Arachnids; Insects.
VII. MOLLUSCOIDS. Polyzoans; Brachiopods.
VIII. MOLLUSKS. Acephals; Gastropods; Cephalopods.
IX. PROTOCHORDATES. Tunicates.
X. VERTEBRATES. Fish-like Vertebrates; Leptocardians; Selachians; Fishes; Amphibians; Reptiles; Birds; Mammals.

GENERAL ZOOLOGY.

Cell changes.—A number of experiments have been made by Dr. O. Lacharias to determine the effect of various media and environments on the behavior of cells. The mixture used by him was a 5 per cent. solution of sodic phosphate in distilled water, and the objects experimented upon were especially the cylindrical spermatozoa of *Blyphemus pediculus*, and the amœboid cells of the intestinal epithelium of *Stenostomum leucops*. The changes undergone were remarkable, and the amœbiform cells of the *Stenostomum* "became like flagellate infusorians, each with a long, thick, rapidly moving process, beside which two or three cilia were sometimes seen beating at the original much slower rate." These experiments, supplimenting previous ones, especially those of Schneider, Brass, and Kühner, are "interesting as illustrations of the readiness with which cells may pass from one phase to another in response to environmental influences, and are thus full of suggestion in relation to normal and pathological cell variation, affording additional experimental proof of the theory of a primitive cell-cycle, advanced by Geddes." (*Biol. Centralblatt*, v. 5, pp. 259–262; *J. R. M. S.*, (4) v. 5, pp. 1014, 1015.)

Colors of cold-loving animals.—The colors of Arctic and Alpine animals have been commented upon by Prof. Lorenzo Camerano, of Turin. His observations had reference especially to the Lepidoptera, and are in brief as follows:

(1) "A sensible mutation of color is observed in many mammals, now more, now less distinctly, and generally it concurs with the change of coat. Also not seldom in mammals strictly belonging to the Alps," as in the chamois and the ibex, "the color changes very late in the summer and in the winter, although the length, the thickness, and also the coarseness of the hairs were very different." In other cases, as, for example, in a Chinese deer (Cervus mandarinus), "the coat is, in summer, light reddish-yellow, with many round white spots, while in winter it is dark brown, and the round spots are less numerous and are light brown."

(2) "As to the insects, it is observed that in Coleoptera the colors of the Alpine species are brighter than those of the warmer plains," and various species found at the greatest elevations of the Alps have often lighter colors.

(3) "A darker color" is observed "generally in the insects of the deserts," as in that of Sahara, while—"on the contrary, mammals in these countries present in general a very light color."

(4) "A very remarkable melanism is also observed in several mammals as well as the reptiles and beetles that are in little islands."

(5) "In the reptiles and in the Alpine amphibia, we sometimes meet with some cases of darkening, but the cases of a remarkable brightening are not very rare, as for example, in the tadpoles of Rana muta," a kind of frog.

(6) "A sensible difference is observed in the coloration between the Arctic birds and the Antarctic. In the last, black is much more abundant."

The causes "that intervene to modify the color of animals are very complicated; climate has amongst these a certain importance," but

Professor Camerano does not think that a "theory of radiation is sufficient" to account for all the phenomena observed. (*Nature*, v. 32, p. 77; see, also, reply by Mr. Meldola in same vol., pp. 172, 173.)

Temperature maxima for marine animals.—A series of experiments has been undertaken by Dr. J. Frenzel for the determination of the maximum heat under which certain animals can live. The first experiments were commenced by subjecting some to a temperature of 40° C. This was supported by a Holothurian for two hours. A Diopatra died in about five minutes; a large tectibranchiate gastropod (Pleurobranchæa meckelii) exhibited at first lively movements, but after five minutes became torpid, although it was not killed; four minutes were enough for a lobster-like crustacean (Scyllarus). "As the Holothurian was the largest of the animals experimented on, the author points out that, although the chief reason for its power of resistance might be sought for in its size, yet the others were conquered too rapidly." Consequently, it was to be inferred that the Holothurian is really capable of resisting heat to an unusual degree.

Further observations were made at a starting point of 30° C., and of the animals thus experimented upon an Ophiuroid (Antedon) began to break up in two seconds; the Diopartra survived for eighteen hours; a chætopod worm (Terebella) showed the effect of heat at 25° C.; a tectibranchiate gastropod (Sea-hare or Aplysia) lived at 26°; a pectinobranchiate gastropod (Murex) "bore 30° for a long time;" and a Scallop (Pectem) "showed some resistance;" a Scyllarus "could bear 25°, but died slowly at 26°, and more quickly at 27°;" and a prawn (Palæmon) "died at 26°;" a fish (the Sea-horse or Hippocampus) "bore 27° well, and lived for an hour at 30°."

In fine, "many marine animals were found to bear high degrees of temperature for an astonishingly long time, as Actiniæ, Murex, Tethys, and Aplysia. But it is not yet certain what heat they can permanently bear. It is also important to discover how winter animals comport themselves towards increase of temperature, and especially animals such as the Heteropoda and Phronima, which are quite wanting in the summer; from what we know we must suppose that at the beginning of summer, when the temperature of the sea becomes raised, they make their way to greater depths, where the heat is less." (*Arch. f. gesammt. Physiol.*, v. 36, pp. 458–466; *J. R. M. S.* (2), v. 5, pp. 791, 792.)

PROTOZOANS.

Rhizopods.

Differentiation in Amœbas.—Although proverbially protean and unstable, the Amœbeans nevertheless exhibit differences which aptly distinguish them into forms generally considered to be of specific value; such differences have been especially insisted upon by Dr. A. Gruber. Dr. Gruber contends that "there are a number of separate and exactly definable Amœbæ which do not pass into one another," and this decision he gives as the result of observations by himself "for months and even years, of forms living in the same locality." The differences are manifested in the "average size, the consistency of the protoplasm, and the movements thereby conditioned, as well as in the characters of its contents, such as vacuoles, granules," and crystals, and also, more especially, in the number, size, and structure of the nuclei. Ten species are described by Dr. Gruber; five of them are multi-nuclear, and "it is proved how definitely the nuclei are distinguished from one another, and with what certainty one can conclude from external characters on the structure of the nucleus," and the reverse. It further follows that "two very similar species of Amœbæ may have very differently-formed nuclei, and that in forms which are externally very different the nuclei may be quite similar; in any case, the number of the different forms of nuclei is much more important than has hitherto been supposed."

The "only differentiation in the body of an Amœba obtains at the outermost periphery, where the protoplasm clearly, from contact with water, is converted into an invisible cuticula-like layer, which disappears during the outpushing of the pseudopodia and can be re-made."

Dr. Gruber denies the existence of "a plexiform structure of the protoplasm" as well as refractive bodies, such as have been described to Pelomyxa palustris.

As to the "pale filaments" which have been found in some Amœbæ, they "appear to be symbiotic fungi;" "in one species, which was remarkable for the constant collection of chlorophyll containing food, they were always present."

Among the species of Amœbæ recognized by Dr. Gruber is the *A. villosa*, first described by Dr. Leidy from specimens found about Philadelphia, and the discovery in Europe of this species "confirms the doctrine that the fresh-water Rhizopods are cosmopolitan organisms." (*Zeitschr. f. wissen. Zoolo.*, v. 41, pp. 186–225, 3 pl.; *J. R. M. S.* (2) v. 6, pp. 260, 261.)

Sporozoons.

Development of Gregorinids.—An important contribution to the developmental history of the monocysted Gregorines has been published by G. Ruschhaupt. His observations were chiefly made on those infesting common earth worms or Lumbricids. Seven species of Gregorinids were found in the worms, which have been more fully described, at least as to some points, by the author. The process of encystation, the formation of sporoblasts, the presence of macrospores and microspores in a single cyst, and the entrance of spores into the sperm-mother-cell were especially observed in one or other of the Gregorinids mentioned. The connection between the Gregorinids and the generative products of the earth worms, the infection of earth worms with Gregorinids, and the relations between the parasites and coccidia have been also considered. (*Jenaische Zeitschr. f. Naturwiss.*, v. 18, pp. 713–750 (1 pl.); *J. R. M. S.* (2), v. 5, p. 665.)

Infusorians.

Artificial multiplication of Infusorians.—With a view to determine the behavior of Infusorians when vivisected, A. Grüber experimented on the *Stentor cœruleus.* (1) First, an individual was bisected transversely, and on the following day each of the parts had become a perfect individual; (2) one of these was likewise bisected, and again on the following day the two sections had developed into perfect animalcules; (3) one of the second bisection was also cut transversely, and again (4) one of the third bisection. In both instances the sectionized parts became perfect individuals on the day of their division. The result of the experiments thus noticed, and others, further served to show also that the sections without a nucleus, although they did well, "never grew up into complete animals," as did those with a nucleus. The presence of a nucleus, in fact, is perhaps a necessary element for complete regeneration. (*Biol. Centralblatt*, v. 5, p. 137; *J. R. M. S.* (2), v. 5, pp. 658, 659.)

PORIFERS.

Sponges.

Reproduction of the fresh-water sponge.—The reproductive process has been investigated by Dr. W. Marshall in one of the common European fresh-water sponges, *Spongilla lacustris.* The gemmules or winter embryos are formed in the neuter autumn sponge from wandering nutritive amœboid cells, known as trophophores, which accumulate in the inhalent corals or in the ciliated chambers. The embryo is at first a "morula-like mass of round uniform cells." It escapes from the capsule in which it is invested in April or early in May. In about a month after the escape of the embryo from the capsule, maturity and complete sexuality are attained. "It seems probable that the males are destitute of enteric cavity and mouth," while the females are "usually provided" with such. After fulfilling their sexual functions the "males seem to perish." The females bear "neuter forms" and then increase in size, but the "enteric cavities and mouth-openings are reduced in size, and not unfrequently disappear." In fine, there is "a seasonal alternation of generations; the winter gemmulæ form spring sexual spongillæ which produce sexual forms in which arise the winter gemmulæ." (*Sitzungsber. Naturf. Gesellsch. Leipzig*, 1884, pp. 22–29; *J. R. M. S.* (2), v. 5, pp. 1011, 1012).

CŒLENTRATES.

Polyps.

A new family of Pennatulids.—The interesting group of Pennatulids, which was named by Kölliker the "Junciformes," has received an interesting addition during the past year, in the shape of a new species, representing even a new family of the group; specimens were obtained in Japan and have been described by Prof. A. A. W. Hubrecht under the specific name *Echinoptilum Macintoshii* and the family name Echinoptilidæ. It belongs to the "section Spicatæ," and (as just noted) "subsection Junciformes" in Kölliker's classification, and is "characterized by the total absence of anything like an axis, which is present in all Pennatulids except some of the primitive Veretelleæ and the divergent Renilleæ."

The polyps form a dense colony, which is rigid on account of the development of calcareous needles, "which, on the rachis, unite to form projecting polyp cells." The needles are in the internal framework, as well as in the investment; the polpy-cells are arranged in less distinct rows than in Stachyptilum, and the ventral is not wholly devoid of polyps. Of all the specimens available for examination the polyps had undergone desiccation, and consequently could not be fully described. But it appeared plain that not only does the new type constitute a distinct family, but, according to Professor Hubrecht, it must be also recognized as representative of a group of higher rank intermediate between the groups already known. (*Proc. Zool. Soc. London*, 1885, pp. 512–518, 2 pl.; *J. R. M. S.* (2), v. 6, p. 81.)

Acalephs.

Radial disposition of Acalephs and Echinoderms.—The problem of the number of segments in the radiate animals has been taken up by Dr. W. Haacke, and he has sought to determine the primitive number of such. Professor Haeckel considered that the star fishes were nearer the ancestors of the Echinoderms than any other group, because in them there is a variation in the number of arms in some species, although in most the number is five, while in the sea urchins, or Echinoids, and Holothurians, the number is constant and always five. Dr. Haacke, however, maintains that in Amblypneustes, one of the sea urchins, he has seen individuals with four and others with six parameres or radial sections, and that therefore Haeckel's views are militated against by such facts. As to the Acalephs, according to Haeckel, the primitive number of parameres in the Medusæ is four, and with this view Dr. Haacke is inclined to agree. He further thinks that it is possible that the typical number of parameres in the Echinoderms is four and not five, but he admits that the question is still an open one. (*Zool. Anzeiger*, v. 8, pp. 505–507; *J. R. M. S.* (3), v. 6, p. 48.)

ECHINODERMS.

Crinoids.

Several important memoirs on crinoids have appeared during the past year, or late in 1884. One of these is by Dr. Herbert Carpenter, and furnishes a volume of the series of memoirs devoted to the elucidation of the material collected by the Challenger Expedition. Another is a systematic revision of the extinct American crinoids published in the "Proceedings of the Academy of Natural Sciences of Philadelphia" by Messrs. C. Wachsmuth and F. Springer. The concluding portion of the latter will be published in 1886. A further notice of these and other memoirs is therefore deferred.

Asterioids.

Nervous system of star-fishes.—In a memoir on the histology of Asterioids Dr. O. Hamann has elucidated several interesting, and among them is additional information respecting the nervous system. The well-developed oral nerve-ring has long been known, but besides this there is, according to Dr. Hamann, "a nerve-plexus in the oral disk; this consists of nerve-fibrils with scattered ganglionic cells, which pass into the epithelial cells of the disk." In fact, an arrangement is manifested "comparable" to one previously observed by Dr. Hamann himself in the Holothurians. (*Nachr. K. Gesellsch. Wiss.*, Göttingen, 1884, pp. 385, 386; *J. R. M. S.*, (2), v. 5, pp. 652, 653.)

Echinoids.

Compound eyes in Echinoids.—In a Diadematid (probably *Diadema Setosum*) occurring at Trincomalee, some peculiar characteristics have been discovered by Drs. C. F. and P. B. Larasin. That sea-egg is covered with blue spots. One of these, when examined under the microscope, shows on the surface "a mosaic" of polyhedra ("generally irregular hexahedra," but also pentahedra) which are so disposed as to call to mind the compound eyes of insects or crustaceans. "Each polyhedron corresponds to a pyramid of very highly refractive substance, the blunt edge of which is invested in pigment;" there "may be one hundred or as many as one or two thousand pyramids in one spot; over all of them the body-epithelium forms a thin ciliated layer, which may be regarded as the cornea;" further, "each pyramid consists of a number of vesicular cells with quite hyaline contents, and in many of them there is a distinct nucleus; this region may be regarded as that of the lens and crystalline body." These organs are "directly placed on a ganglionic plexus," and there is no distinct nerve intervening between the two. When a hand is directed towards a point where these organs are developed, the surrounding spines are seen to turn towards the spot. It has been therefore inferred that the spots in question have the junction of eyes capable at least of appreciating the difference between "light and shade." (*Zool. Anzeiger* v. 8, pp. 715-720; *J. R. M. S.*, (2), v. 6, p. 253.)

Holothurians.

Values of differentiating characters.—The various parts and organs of the *Holothurians* have been examined by Dr. K. Lampert, in order to determine the systematic values thereof and the best means of classifying the groups. "The arrangement of the ambulacral suckers varies with age." The calcareous deposits are much less variable, and in but few cases are there notable differences, according to age or otherwise. The tentacles appear to furnish the best differentiating characters. The combination of *Dendrochirotæ* introduced by Prof. Jeffery Bell is adopted. Further, the distribution of the tentacles into one or two rows affords good grounds for a division into groups, to be called respectively, "*Monoçyclia*" and "*Heterocyclia*." A new and systematic monograph of the order is promised by Dr. Lampert. (*Biol. Centralblatt*, v. 5, pp. 102–109; *J. R. M. S.*, (2), v. 5, pp. 1007–1008.)

WORMS.

Rotifers.

The relations of the Rotifers.—Much diversity of opinion has prevailed as to the relations of the Rotifers to other classes of the animal kingdom. The subject has been taken up recently by Dr. L. Plate in connection with a monograph of the fresh-water rotifers observed by him. He considers that it is clear that "sexual dimorphism is an acquired character." The progenitor of the class ("Archirotator") is supposed to have had a cylindrical body narrower behind, a ventral mouth and dorsal anus, and an aboral tuft of cilia; the wheel apparatus consisted of two ciliated circlets; the fore-gut had a chitnious masticatory apparatus, and the whole tract was lined by ciliated epithelium; into its hinder portion opened two unbranched excretory canals and the genital ducts. The nervous system consisted of a dorsal central ganglion, which gave off several anterior and two postero-lateral nerves. As to their systematic position, the Rotifers appear to be of the same stock as the Annelids, but they differ from the Trochophore in wanting a ciliated groove; the hinder circlet of cilia opens into the fore-gut, the aboral tuft does not correspond to the perianal circlet, and the brains are not homologous." (*Jenaische Zeitschr. f. Naturwiss.*, v. 19, pp. 1-120, 3 pl.; *J. R. M. S.* (2), v. 6, pp. 76–78.)

Platyhelminths.

New York Turbellarians.—An important memoir on the fresh-water Turbellarians occurring especially in Monroe County, New York, has been published by Dr. W. A. Silliman in the "*Zeitschrift für wissenschaftliche Zoologie*" (v. 41, pp. 48–78, with 2 pl.). Twenty-one species have been recognized, of which a considerable number, it is supposed, are common to America and Europe. Dr. Silliman considers the groups named Rhabdocœla, Tridada, Polycloda, and Nemertinea to be of approximately equal value and representing four "orders" of Turbellarians.

Nematelminths.

Nervous system of tape-worms.—Although the nervous system of the tape-worm was discovered half a century ago, the subject has remained in considerable obscurity, and recent research by Dr. J. Niemiec is therefore timely as throwing light on some of the controverted and doubtful points at issue. Dr. Niemiec's researches were based on sections of the scolices of T. cœnurus, T. elliptica, T. serrata, and T. mediocanellata. The different parts are considered under four categories.

(1) A "*nerve ring*" situated under the hooks, from which "filaments run to the hook musculature, while from ganglionic swellings eight branches descend, four going to the principal lateral ganglia, and four prolonging their course even within the proglottides."

(2) A "*central ganglion*" in the middle of the "principal commissure," joining the two lateral ganglia, and "from which a 'transverse commissure' passes at right angles to the 'principal.'"

(3) "*Polygonal commissures*," in the plane of the two chief commissures, formed by "nerves which unite the two lateral ganglia with the branches descending from the nerve-ring and with the transverse commissure," and parallel to it, "a little below, there lies an 'inferior polygonal commissure' of the same nature. Where the different branches join, 'secondary ganglia' are situated, and from these, as well as from the principal lateral ganglia, the suckers are supplied with nerves, four to each."

(4) "*Spongy cords*," ten in number, three pairs starting from the principal lateral ganglia and the remaining four (as already noted) "descending from the nerve-ring and passing through the 'secondary ganglia.'"

In conclusion Dr. Niemiec insists upon (1) the resemblance between the nervous system of the tape-worms and that of the Tetrarhynchi; and (2) the homologies of the nerve-ring of the tape-worms with the oësophageal ring of the annelids, "from which it differs only in its less pronounced development or reversion to a more rudimentary form," and (3) the diminished gap which intervenes between the cestode and trematode nervous systems. (*Recueil Zool. Suisse*, v. 2, pp. 589–648; *J. R. M. S.* (2), v. 6, pp. 75, 76.)

Annelids.

Deep sea Annelids.—The deep-sea types of a few classes, such as the fishes and Holothurians, are, to a large extent, much differentiated from the shallow-water forms, but those of other classes are comparatively little divergent from littoral species. Among the groups of the latter category are the Annelids. The rich material collected by the Challenger expedition has been the object of study to Prof. William C. McIntosh for seven years, and the results thereof have now appeared in the form of a large quarto volume constituting the entire twelfth of the Challenger reports.

Under the heading of "classification" (p. viii) Professor McIntosh states that "the large number of new forms brought within our knowledge by the Challenger would have been supposed to lead to a noteworthy change in classification, but from the first it was apparent that no new family was required. All the types fell under the groups already constituted, and which have been very satisfactorily given by Malmgren in his Annulata Polychœta" (1867). Much "experience has not as yet shown the necessity for any material change." It is admitted, however, that "there are some forms, such as the genus Eulepis" (retained in Polynoidæ) which almost merit the distinction of a separate family, but they have only recently been discovered and may properly be left for further investigation."

Two hundred and twenty new species are described by Professor McIntosh.

ARTHROPODS.

Merostomes.

Embryology and morphology of Limulus.—The horse-shoe crab, or Limulus, has been the subject during the past year (as in previous years) of investigation with reference to its embryology, morphology, and systematic relations. Of American naturalists, Dr. J. S. Kingsley has contributed an important memoir on the embryology of Limulus to the "English Quarterly Journal of Microscopical Science" (v. 25, pp. 521–576, 3 pl.), and Prof. Henry L. Osborn, Dr. W. K. Brooks, Mr. A. T. Bruce, and Mr. W. H. Howell have communicated preliminary notices of investigatons to No. 43 of the "Johns Hopkins University Circulars." One, by Professor Osborn, is on the "Metamorphosis of *Limulus polyphemus*" (p. 1), a second, by Dr. Brooks and Mr. Bruce, is an "Abstract of Researches on the Embryology of *Limulus polyphemus*" (pp. 2–4), and a third, by Mr. Howell, is "On the Chemical Composition, &c., of the Blood of *Limulus polyphemus*" (pp. 4, 5). Dr. A. S. Packard has also published in the American Naturalist (v. 19) a supplementary memoir on certain points of the embryology of the same species. Important memoirs have been likewise published by Prof. E. Ray Lankester and several associates or students, in the "Quarterly Journal of Microscopical Science," and the "Transactions of the Zoological Society of London."

Arachnids.

Sense organ in legs of spiders.—The peculiar structural modifications of the legs which have been observed in certain spiders by Bertkau and Dahl, and considered to be sensory organs, have been studied anew by Professor Schimkenitsch. The structures in question have been found in most of the leg joints in a number of spiders, and in both males and females. They are superficially thin chitinous plates with thickened borders, whose opposite sides are connected by parallel thickenings, and in cross-sections are to be found "round these organs a layer of remarkably tall pigmented cells," and "between these are ganglion cells with prolongations directed towards the chitinous layer." These are thought to be analogous to the "chordotonal organs" of insects. (*Zool. Anzeiger*, 1885, pp. 264–266, 537, 538).

Dimorphism in spiders.—Several observers have determined that certain spiders have two broods, and that the individuals of the two differ more or less, in a few cases the differentiation having been considered as specific. The so-called *Meta segmentata* and *Meta Mengei*, for example, represent several broods of one and the same species. In other cases, however, there is but little difference between the two broods. (*Zool. Anzeiger*, 1885, pp. 459–464, by Bertkau; 532, 533, by Korsch.)

Crustaceans.

A nervous system in the Centrogonida.—The singular degraded crustaceans, known as Peltogaster and Sacculina, which have been differentiated into a distinct order called Rhizocephala or Centrogonida, have a nervous system so rudimentary and obscure as to have escaped observation until the past year. Mr. Y. Delage resolved to supply the deficiency, and after two years of observation he found it in Sacculina, while in Peltogaster, on the other hand (although the absolute difficulties of the search were exactly the same as in Sacculina) he found it in the first individual dissected after less than an hour's work. He mentions this particular only to show the value of the morphological method, and if he found this nervous system it is by no means due to particular address in dissection; it is because, armed with the morphological data derived from the study of Sacculina, he sought for it precisely where it ought to be found. When one knows where to look for it, he remarks, it is easy to find, but this last condition is indispensable, and it is from not having this requisite knowledge at their disposal that the numerous authors who have previously investigated the genera in question failed to discover it. The ganglia are displaced and in apparently different relations on account of the position of the ovaries and other parts. In these displacements, was the nervous ganglion to retain the original position at the bottom of the ovary, or was it to follow the cloaca, or the mesentery or the cement-glands? Observation has shown that it did not remain immovable; therefore its relations with the declivous pole of the ovary are not at all essential; it had followed the cloaca and the mesentery, but especially the cement-glands, in their movements; hence it is with these organs, and chiefly with the last named, that it has fundamental relations. On the other hand, we see that the close relations of the ganglion with the testes in Peltogaster are quite accidental, since in Sacculina these organs are as far apart as possible. Henceforward in seeking for the nervous system in other Centrogonida, in which the viscera may again affect new relations, we see that we shall not have to pay any attention to the testes, or to the anti-peduncular pole of the ovary, and that it is between the cement-glands, in the sagittal plane, and perhaps slightly towards the cloaca and the cement-glands, that we must direct the forceps and the scalpel. It is only by the study of a type in which the cement-glands may be far removed from the mesentery and the cloaca that we can see whether the nervous ganglion would entirely break off its relations with the latter two organs and follow the cement-glands in their displacement. (*Comptes Rendus* Acad. Sci. Paris, 1885, p. 1010; *Ann. & Mag. Nat. Hist.* (5), v. 15, pp. 495–498.)

Blind sessile-eyed crustaceans.—The structure of the brain in sessile-eyed crustaceans, and especially that of the Asellus communis and Cecidotæa stygia, has been investigated by Prof. A. S. Packard. The brain of such forms has not ganglion and cells with a simple nucleus, as does that of a lobster and other stalk-eyed crustaceans, but ten to twenty nuclei appear to a cell. The brain is therefore far less complicated than that of the stalk-eyed crustaceans and is "a syncerebrum, the components being the brain proper or pro-cerebral lobes, the optic ganglia, and the first and second antennal lobes," and these lobes are quite separate from each other.

As to the blind species Professor Packard thinks that "the steps taken in the degeneration or degradation of the eye, the result of the life in darkness seem to be these: (1) the total and nearly or quite simultaneous loss by disuse of the optic ganglia and nerves; (2) the breaking down of the retinal cells; (3) the last step being, as seen in the totally eyeless form, the loss of the lens and pigment." Professor Packard considers this evolution to be explicable upon what may be called "Lamarckian" principles. (*Mem. Nat. Acad. Sci.*, v. 3, part 14, p. 5.)

Insects.

Extinct myriopods.—As a result of a study of the fossil myriopods, Mr. Samuel H. Scudder has admitted two extinct orders. The Archipolypodous type is the oldest, and Mr. Scudder considers that there is evidence that some of the Carboniferous forms were amphibious. The group culminated in the Carboniferous, and does not appear later than the Dyas, while with one doubtful exception no true diplopod is know to be older than the Oligocene. The Archipolypoda, which resembled the Diplopoda in having two pairs of legs to every segment, became extinct in the Palæozoic epoch. Three families have been recognized, the Archidesmidæ, Euphorberiidæ, and Archijulidæ. Another extinct type is found in the Protosygnatha, which are characterized by the development of only a single pair of legs to each segment, in which respect a resemblance is manifested to the Chilopoda. One genus only, Palæocampa, is known from the Carboniferous.

For a brief period after leaving the eggs, modern Diplopods and pauropods have a shorter body than in after life, and the first three segments bear but a single pair of legs.

In adult life, these first three segments still bear but a single pair of limbs, while all the other segments which exist in the larval state, and those which develop afterwards, bear two pairs. The Chilopoda have the same three anterior pairs of legs, early and permanently developed as organs of manducation, while all other segments have but a single pair. Palæontological evidence is in favor of the view that the dorsal scutes of Diplopoda are compound.

The sight of insects.—The power of vision of insects has been investigated by Prof. Felix Plateau, whose special aim was to determine whether insects can distinguish the form of objects. It has been contended by certain authors that such insects as possess compound eyes cannot distinguish form, and that vision operates in a different way from that generally admitted, and consists mainly in the perception of movements. To some extent this view is sustained by Professor Plateau as the result of a series of experiments. He concluded from these that "insects only utilize their eyes to choose between a *white* luminous orifice in a dark chamber, or another orifice or group of orifices *equally white.* They are guided neither by odorous emanations, nor by differences of color. A fact which will certainly astonish all entomologists, and likewise surprise the experimenter himself, is, that bees have as bad sight and comport themselves almost as flies."

Professor Plateau directed his observations to many widely different insects, belonging to the orders of Diptera, Hymenoptera, Lepidotera, Odonata, and Coleoptera, and the experiments spoken of were essentially harmonious. The following conclusion resulted:

(1) "Diurnal insects have need of a quick, strong light, and cannot direct their movements in partial obscurity.

(2) "In diurnal insects with compound eyes, the simple eyes offer so little utility that it is right to consider them as rudimentary organs.

(3) "Insects with compound eyes do not notice differences of form existing between two light orifices, and are deceived by an excess of luminous intensity as well as by the apparent excess of surface. In short, they do not distinguish the form of objects, or, if they do, distinguish them very badly." (*Am. Nat.*, v. 20, pp. 69, 70.)

Adherence of insects to ceilings.—There has been considerable difference of opinion as to the method by which flies and insects generally adhere to the ceilings and walls of rooms and analagous surfaces, and the subject has recently been investigated by Herr H. DeWitz. His researches tend to prove that the secretions by which flies, for example, adhere to the window panes is not a thin fluid of a fatty nature, but much more consistent. He adduces experiments to controvert Rombout's view that a fly can maintain itself on a glass surface by one leg only, if that surface be vertical and if the body of the fly be in contact with the glass. (*J. R. M. S.*, Oct., 1885; *Am. Nat.*, v. 20, p. 1221.)

Insects of the coal period.—The additions to our knowledge of the insect fauna of the early periods of the earth's history have been very great during the past few years, and a deposit of species from the Carboniferous beds at Commentry, in the department of Allier, France, has contributed a number of new types and furnished data for forming an enlarged survey of the ancient insects. A French naturalist, Mr. C. Brongniart, has been able to study the remains of 1,300 specimens, among which not only the wings but sometimes the bodies have been preserved. He corroborates the impression that has already obtained, that the venation of the wings, which is generally so good a guide in the appreciation of recent species, not only fails to a large extent, but is even liable to lead into error in the case of the ancient forms; nevertheless, in spite of such discrepancies, the most ancient insects are, in some respects at least, surprisingly like those of the present time, and only differ in comparatively unimportant respects.

Among the insects of the Commentry deposit occurs the first fossil Thysanuran, represented by 45 specimens. It is supposed to be related to the existing Machilis, but differs from all living representatives of the order by having a single caudal filament. The species has been named Dasyleptus lucasi.

The Orthopterous insects are represented by species which recall the Phasmids or leaf insects of our day, but are segregated by Brongniart in a special order under the name Neurorthoptera. Of this type two major groups or suborders, with numerous distinct generic types, referable to about five families, have been made known.

The Homopterous insects were represented in the deposit by five genera.

The Pseudo-neuroptera had forms that were still more varied; six families have been recognized for the carboniferous species. (1) One was a group of eight new genera of a family to which the name of Megascopterida has been given: The abdomen had respiratory appendages and the problematical *Breyeria Borinensis* is regarded as being a species of the family. (2) Another family, called Protodonata, is recognized for forms somewhat resembling the dragon flies or Libellulidæ of the present age. Four other families, the Homothitida, Protephemerina, Protoperlida, and Protomyrmeleonida, furnish additional species of the Pseudoneuroptera. (*Am. Nat.*, v. 20, pp. 68, 69.)

Crickets infested by Gordius or thread-worms.—Numerous insects harbor Gordius or thread-worms during some portion of their life history, and some recent interesting observations were communicated by a lady of Groton, N. Y., Mrs. C. W. Conger, to the Rev. Dr. Henry C. McCook. On one occasion she noticed that a cricket mounted upon the edge of a pail, and after some uneasy movements brought the tip of the abdomen just beneath the water, and, with a few violent throes, expelled a black mass, which fell slowly through the water, and before it reached the bottom resolved itself into one of the worms. "The cricket seemed exhausted by the horrid birth, and did not find strength to draw itself up on the edge of the pail for about eight minutes, and when it finally did so, it tumbled to the floor and crawled off in a very rheumatic manner. After this discovery we used to amuse leisure hours by watching like operations until frost killed the crickets. I sometimes would crush large crickets, generally with the result that a tightly-coiled snake would be thrust out of a rupture just above the tip of the abdomen; but whether the snake was not sufficiently developed or because of its needing water rather than air to vitalize it, none of the snakes so produced showed any signs of life."

MOLLUSCOIDS.

Polyzoans.

Use of avicularia in classification of the Polyzoans.—The so-called chitinous parts (operculum and avicularia) of the Polyzoans had been much neglected until lately, but Messrs. A. W. Waters and G. Busk have paid special attention to such parts with decided benefit to the systematic arrangement of the chilostomata. The modifications of the operculum especially were described when practicable by Mr. Busk in his elaborate report on the species collected by the Challenger expedition. The avicularian mandibles were also investigated to some extent by Mr. Busk; and, according to Mr. Waters, "to him we must give the credit of first applying the form of the mandible in specific determination." A fuller discussion "On the use of the avicularian mandible in the determation of the chilostomatous Bryozoa or Polyzoa" has been contributed by Mr. Arthur W. Waters. Various points are discussed, but only a couple can be here noticed. "The process in the chitinous mandibles" Mr. Busk calls a columella, and says that "it is covered with short hairs," but these, upon comparison with other mandibles, turn out only to be the remains of the attachment of the muscular threads. In fine, the processes in the mandibles, especially of *Cellepora* and *Adeona*, "indicate differences in the muscular attachments, and both here and in the opercula it is really the muscular system which has the greatest classificatory value; but this is best studied by means of the variations in the chitinous parts." (*J. R. M. S.* (2), v. 5, pp. 774–779, pl. 14.)

Brachiopods.

Vascular and nervous systems of Brachiopods.—Some points in the structure of the Brachiopods are very difficult to determine for one reason or another, but new light is gradually being thrown on such. Several doubtful points have been investigated by Dr. F. Blochmann. The heart and its contractibility were early correctly observed by Professor

Hancock. Occasionally, as in the *Argiope neopolitana*, there are two hearts. On the other hand, in some forms, as *Crania anomala*, there is "no heart," but "numerous enlargements on the 'vein.'" The so-called "afferent brachial canal" of Hancock is now affirmed to be "really the supra-œsophogeal nerve," and "further, the plexus which Hancock describes as circulatory, are really branching and anastomosing connective tissue-cells." In one of the examined Brachiopods (*Crania anomala*) the supra-œsophageal ganglion is replaced by a "narrow fibrillar commissure." A "brachial vessel, sending off vessels to the cirrhi, runs along the whole length of the brachial sinus behind the œsophagus, communicating by paired branches with the œsophageal blood-sinus, and so with the heart." (*Zool. Anzeiger*, v. 8, pp. 164–167; *J. R. M. S.* (2), v. 5, p. 440.)

MOLLUSKS.

Acephals.

Action of the foot in bivalve mollusks.—The movements of the foot in Lamellibranchs, or the bivalve mollusks, have been studied by Dr. A. Fleischmann. It is maintained that the so-called aquiferous pores in the foot are "neither the orifices of glands nor artefacts. This being so, they cannot serve as a means of communication between the blood vascular system and the surrounding water. Such streams of water as are seen on contraction are not normal vital phenomena, but are pathological. Even if there were pores, they could not, for mechanical reasons, have the functions that have been ascribed to them. The swelling of the foot is due to the entrance of a certain quantity of blood, which, during repose, is stored up in the pallial reservoirs; the blood is aided by the closure of a strong valve and by the simultaneous relaxation of the musculature of the foot, the lacunæ of which become filled by blood. When the foot undergoes erection there is no change of volume of the whole animal, but only a change in the volume of separate parts, due to the dislocation of the blood. It has not been proved that water is taken up by the kidneys or intercellular ducts. The Lamellibranchs do not need to take in water. What is true of them is also true of other groups of mollusks." (*Zeitschr. Wiss. Zool.*, v. 41, pp. 367–431; *J. R. M. S.*, v. 6, p. 52.)

Byssogenous glands and Aquiferous pores in Lamellibranchs.—The byssogenous glands and pores of bivalve mollusks, as well as the so-called aquiferous pores of the foot, have been studied by Prof. T. Barrois.

"In the present state of knowledge," he indicates, "it is generally admitted that the byssus is the secretion of special glands," but the extent to which such glands are developed had not been known until the professor was able to demonstrate that Lamellibranchs generally exhibit more or less well marked traces of this byssogenous apparatus.

In such forms as have the glands moderately developed, such as the common European cockle (*Cardium edule*), the organ consists of "a groove on the lower surface of the foot, of glands at the side of the groove, of a canal which extends from it to the more or less spacious cavity of the byssus, and of compact masses of byssogenous glands which pass the products of their secretion into the cavity." This cavity as well, and also the canal and the groove, are lined with a cylindrical epithelium. In the common cockle the byssus is formed by "a simple hyaline filament."

In those forms in which the glands are more developed, such as the common mussel (*Mytilus*), *Pinna*, and others, "the glands are much denser, and the anterior extremity of the foot is prolonged to form the linguiform muscle; the lamellæ of the cavity of the byssus are more numerous," and the byssus is formed of a number of filaments constituting a tuft. "In Anomia differentiation is carried much further, for the byssus becomes charged with carbonate of lime," and compact, so as to form the so-called ossicle.

In still other forms, "the organ undergoes great retrogression," and there may be "a very short groove, or none, and no glands," as in *Donax* and *Tellina;* "sometimes the groove and cavity are present, but no glands exist," as in *Nucula*, while in others "only a delicate blind canal can be distinguished, formed by a simple layer of epithelial cells," as in *Psammobia*. And in few forms is there a complete absence of groove, cavity, or glands. *Pholas* and *Solen* are examples of the few.

Professor Barrois has examined more than 50 species and, according to his views, representatives of "every family except the Trigoniidæ and Tridacnidæ," and, inasmuch as the byssus and its associated structures are so generally developed, "he is inclined to regard it as a characteristic organ of the Lamellibrach type."

The so-called aquiferous pores are thought by Professor Barrois to be "nothing more than the orifices of degraded byssogenous glands." It is his opinion that, "if water does really enter the cirulatory system," it "must do so by fine intercellular canals, or by endosmosis, or some other way," but not through the aquiferous pores. (*Comptes Rendus*, Acad. Sc. Paris, v. —, pp. 188–190; *J. R. M. S.* (2), v. 5, pp. 227, 228.)

Structure of bivalve shells.—The bivalve shells have been considered by W. Müller with reference to the attachment existing between the mantle of the animal and the shell Two varieties are recognized. In one the shell is only attached at certain areas to the mantle, and "the organic substance of the mother-of-pearl layer is membranous"; this phase is exhibited by almost all members of the class. In the other variety the shell is "continuously grown to the mantle," and "the organic substance of the mother-of-pearl layer forms a network;" this condition, so far as known, is only exemplified in the little fresh water clam-like shells known as Sphæriidæ or Cycladidæ. (*Zool. Anzeiger*, v. 8, pp. 70–75; *J. R. M. S.* (2), v. 5, pp. 230.)

Gastropods.

The wings or cephalic appendges of Pteropods.—The homologies of the wing-like anterior appendages of the Pteropods are still involved in doubt. In the gymnosomatous forms, especially of the genera Clione, Clionopsis, or Pneumodermon, there are always two pairs of tentacles, and Dr. Pelseneer believes that they are "homologous with the two pairs of the euthyneurous Gastropods." In thecosmatous Pteropods, there is a pair of tentacles so reduced as to be rudimentary, and if the species do not have eyes when adult, they have them in some stage of development; these tentacles are homologous with the posterior or nuchal oculiferous tentacles of the gymnosomatous Pteropods, while the absence of the anterior is to be explained by the swimming lobes encircling the head. "Most of the gymnosomata have a pair of buccal appendages between the two pairs of tentacles, and these, though varied in aspect, are probably similar in origin; it is explained how, in Clione, they are really inserted on the external wall of the buccal cavity just as in Cirrifer and Pneumodermon; but at the same time it is to be remembered that this part of the buccal cavity is an introvert and not a true part of the oral cavity." (*Quart. Journ. Micr. Soc.*, v. 25, pp. 491–509, 1 pl.; *J. R. M. S.* (3), v. 6, p. 53.)

The eyes of Gastropods.—An investigation of the eyes of Gastropods has been undertaken by Dr. C. Hilger. It appears that there are two kinds of optic organs developed in ordinary forms. In the first a rudimentary condition is manifested in that the eye "forms but a slight invagination of the epithelium of the body;" this condition is exemplified in the Rhipidoglossate and Docoglossate mollusks, as in the genera Margarita, Trochus, Haliotis, Fissurella, and Patella. In the second, "the eye forms a complete closed capsule, which is invested by connective tissue." This condition is manifested in the Pectinibranchiates, such as the genera Murex, Nassa, Ficus, Cypræa, and Conus.

In the former type "the eye has the form of a cup or bell shaped invagination of the epithelium of the body," and "in most cases, the cuticle seems to be developed as a very thin lamella over the anterior part of the vitreous body; the invagination is lined by the retina, which anteriorly passes directly into the epithelium of the body and is invested externally by the outspread optic nerve." In the ear-shells (Haliotis) and top-shells (Trochus) "the cavity is filled by a delicate gelatinous substance, and in Patella and Nacella by a finely granulated mass."

In those forms in which the eyes are more developed "the larger and hinder part of the corpuscle is formed by the retina and the outspread optic nerve, while it is closed anteriorly by the inner cell-layer of the pellucida. Within there is either a lens or vitreous body or both," and "the eye is completely invested by the connective tissue of the tentacle," or, as it has been more definitely named, the ommatophor.

For further details, reference must be had to the original memoir of Hilger, published in the Morphologische Jahrbuch, and a fuller abstract in the Journal of the Royal Microscopical Society. (*Morphol. Jahrb.*, v. 10, pp. 351–371, 2 pl.; *J. R. M. S.* (2), v. 5, pp. 222, 223.)

The relations of Sequenzia.—The small mollusks to which the generic name Sequenzia has been given, and which, on account of the appearance of the shell, have been supposed to be related to the Solariids by some, and by others to the Trochids, have, it seems, been quite misunderstood. Prof. A. E. Verrill found in the dredgings of the United States Fish Commission living examples of the genus, and, on examination of the radula and jaws, determined the affinities of the form to be quite different. Professor Verrill approximates the genus (which he raises to the rank of a family) to the Aporrhaidæ, and consequently in the group or suborder of Tænioglossa instead of the Ptenoglossa or Rhipidoglossa.

The family is definable as Tænioglossates with ovate jaws having a tesselated surface and denticulated edge; teeth of the central row small and with a denticle, of the inner lateral smaller and with curved, unarmed tips, and of the two outer lateral slender, sharp, and strongly curved; shell trochiform, its aperture irregular, with a posterior sinus and a short or rudimentary canal or sinus, with a pearly luster, and decussating sculpture, and operculum thin, rounded-ovate, with a subcentral nucleus and five concentric lines. (*Trans. Conn. Acad. Arts & Sci.*, v. 6, pp. 186–191.)

The animal of Adeorbis.—There is a small shell, of a discoid form, found along the European coasts, as to whose relations there have been considerable doubts; its generally accepted name is Adeorbis subcarinatus. The doubts as to its affinities could only be solved by an examination of the anatomy of the animal. This has been undertaken during the past year by Mr. Paul Fischer. He found that the radula has sixty-eight transverse rows of teeth, each row consisting of seven teeth; the central is wide and trapezoidal, and has a reflected summit and basal cusps; the lateral teeth are rhomboid and each has a long, stalk-like lateral process; the inner marginal are long, narrow, and denticulated along its external margin; the external still narrower and with entire margins. It appears, therefore, that Adeorbis has no relations with the Trochids or Cyclostrematids to which some conchologists have been disposed to refer it, and that its affinities are really with the Skeneids and Rissoids, as has been long suspected by others. (*Trans. Conn. Acad. Arts & Sci.*, v. 6.)

The relations of Truncatella.—Along the shores of many countries between tide-marks or even above normal high-water mark are found certain small mollusks having an elongated turreted shell, truncated at the summit, and with a subcircular aperture. These mollusks belong to the family named Truncatellidæ, and they have been generally associated with the Cyclostomids and allied animals and considered to be true air-breathing and lung-bearing gastropods. The correctness of this view however was long ago challenged, and its incorrectness has been shown during the past year by Dr. A. Vayssiere. The study of the respiratory apparatus of the animal reveals the fact that it is a true gill or branchia, which is placed transversely to the longitudinal axis of the body; has itself an elongated form and is composed of twelve to fifteen triangular lamellæ, arranged in a row, but each almost entirely independent of its fellows. On the surface of the lamellæ, and especially toward the free extremity, there are vibratile ciliæ which determine the movements of the water around the organ. It is, therefore, says Dr. Vayssiere, undeniable that the respiration of the animal is by means of branchiæ. The mollusk lives in a moist atmosphere, although not in the water, and therefore it keeps stored up in its respiratory cavity a certain amount of water which is renewed every time that the tides cover its station. Dr. Vaysseire adds some details on the habits of individuals kept in confinement. They had been found on the sea border more or less ensconced in the muddy ooze and in the midst of débris cast on the shore, consisting largely of decaying fruit and animals. The Truncatellas did not appear to be at all affected by the odor of the decaying matter. They could remain out of the water and in an atmosphere saturated with the vapor, and could live many days without suffering, but moisture was necessary and they soon succumbed to dryness. Their progress is peculiar, and the movements of the animal recall those of the geometrical caterpillars. Normally and when in the water it uses only its foot in walking, and does not employ its proboscis save in exceptional cases, and when a special demand is made upon its strength, as when it is creeping upon a vertical and smooth surface, such as the sides of a glass globe. Previous observers, who stated that it always uses its proboscis, were misled by the fact that the mollusk, in its progress (which resembles that of the geometrical caterpillars), performs with the anterior part of its body (the proboscis) a certain looping movement. This movement, which at the same time entails an approach of the extremity of the proboscis to the ground, leads one to suppose that this plays a role in its progress, and one is the more disposed to believe this, as the mouth, which is at the extremity of the proboscis, has very much the appearance of a sucker.

The food of the little animal is chiefly composed of microscopic animalcules (such as Infusorians, Amœbas, Foraminifers, &c.), as well as the decomposing remains of algæ and other aquatic plants. (*Journ. de Conchyl.* (3) v. 25, pp. 255–288, pl. 12, 13.)

North American Land Slugs and Shells.—The terrestrial Gastropods of North America, north of Mexico, which have been treated of to such an extent by Mr. W. G. Binney, have been submitted to a renewed examination by the same gentleman. The results have appeared in a new volume, entitled "A Manual of American Land Shells," which constitutes "No. 28" of the Bulletin of the U. S. National Museum.

The treatment is essentially the same as that in Mr. Binney's previous publications, but instead of the species being arranged in a regular systematic order they are distributed geographically under several categories: (*a*) those "universally distributed;" (*b*) those of the "Pacific province;" (*c*) those of the "central province;" (*d*) species of the "eastern province," and the "northern region" thereof; (*e*) species of the "eastern province" and the "interior region;" (*f*) species of the "eastern province" and the "southern region," and (*g*) those "locally introduced."

After a brief introduction on (1) the "habits and properties," (2) "geographical distribution," (3) the "generative organs," (4) the "jaws and lingual dentition," and (5) the "classification," the author enters upon the description of the species under the geographical categories enumerated.

With Dr. Fischer, he divides the Geophilous Pulmonates (to which the volume is restricted) into two groups (1) the Monotremata, distinguished by having common or contiguous external male and female orifices, including almost all of the species, and (2) the Ditremata, embracing those forms in which the external male and female orifices are widely separated. Of the latter group only two species of the family Veronicellidæ and two of the Onchidiidæ have been observed within the limits mentioned.

The Monotremata are divided into eleven families. These families do not always appear to be very natural and sometimes discordant forms have been combined in one, and sometimes forms for which no differential characters have been noticed have been referred to distinct families.

A résumé of those families to which distinctive characters can be given seems appropriate in this connection.

I. The Glandinidæ include those forms which are entirely destitute of a jaw, and whose teeth are of only one kind, all being elongated, narrow, and aculeate, while the mantle is submedian or postmedian and entirely included in the shell, which itself is elongated or turreted. Of this family five are enumerated as species of the genus Glandina. These, in Mr. Binney's plan, belong to the family Testacellidæ.

II. The Selenitidæ constitute a group, recently recognized by Dr. Fletcher, of which the jaw is ribless, the teeth are of nearly the same character as those of the Glandinidæ and are aculeate, the median one being either suppressed or very small, and the mantle is submedian or posterior and included within the shell, which latter is spiral and heliciform. The species of this group are referred by Mr. Binney to the genus Macroyclis, and six are recognized as inhabitants of the North American fauna.

III. The Vitrinidæ may be considered as embracing the Monotrematous Geophila, with a jaw which is smooth or striated (destitute of ribs) and has a median projection to the cutting edge; teeth differentiated into a central tricuspid one, "laterals of about the same height as centrals, bicuspid or tricuspid, but in latter case furnished with an obsolete inner cusp; marginal teeth differing from the laterals, aculeate unicuspid or bicuspid," and a heliciform shell. This family embraces about fifty-two species, which are referred by Mr. Binney to the Limacidæ.

IV. The Bulimulidæ include forms which have the jaw thin, and provided with distant transverse ribs, the teeth "peculiar by the elongation and incurvation of the inner cusp of the lateral" ones, and the mantle included in the shell which, itself is more or less elongated and turreted. Nine species, referred to the genus Bulimulus, are represented in North America, and are chiefly found in the southwestern regions.

V. The Stenogyridæ include forms which have the "jaw ribbed or finely wrinkled, thin, arched;" the teeth differentiated into (1) a small central tooth, (2) tricuspid lateral teeth having the "central cusp long and narrow" and "side cusps of subequal length," and (3) "marginal teeth, quadrate, very low, wide," and "tricuspid or multifid;" the mantle included, and the "shell generally elongated, polygyral, shining," and with its "apex more or less obtuse." The six North American species are referred to the genera Stenogyra, Ferrussacia, and Caecilianella.

VI. The Helicidæ have a jaw of a single piece (generally arcuate, often ribbed), teeth differentiated into (1) "centrals unicuspid or tricuspid," (2) "laterals unicuspid, bicuspid, or tricuspid, but with the inner cusp obsolete," and (3) "marginals quadrate, low, wide;" the mantle submedian and included in the shell, and the shell spiral and diversiform. The American representatives are distributed by Mr. Binney among two families, the Helicidæ and Pupidæ, but the only differences noticed are as to degrees of exsertion of the spire. The gradations from a discoid helix to an elongated turreted or pupiform shell are so gradual and numerous (especially when foreign forms are taken into account) that no advantage seems to result from the distinction of the two groups. Including both types and eliminating the genera Arion, Ariolimax, Prophysaon Binneya, Hemphillia, and the Punctum pygmæum or minutissimum, one hundred and sixty-seven species have been admitted by Mr. Binney into the North American fauna and distributed among twenty-six genera.

VII. The Limacidæ may be restricted to species having the jaws ribless, the dentition divided into (1) a "central tooth tricuspid," (2) laterals of same height as central, bicuspid or tricuspid, and (3) "marginal teeth differing from the laterals, aculeate, unicuspid or bicuspid," the mantle anterior, small, narrow, and shield-like in appearance, and the shell reduced to a rudiment and concealed under the mantle. All the North American species are referred by Mr. Binney to the genus Limax and are seven in number.

VIII. The Arionidæ include forms which have the jaw entire and transversely ribbed; the teeth of three types, (1) a wide central obscurely tricuspid; (2) lateral, "like the centrals but asymmetrical by the suppression of the inner lower lateral expansion of the base of attachment," and (3) marginals quadrate, low and wide; the mantle anterior, small and shield-like, and the shell represented by a small flat plate or granules. The North American species are referred to two genera, Arion with two species (one introduced from Europe) and Ariolimax with five. These species are interposed between genera of the Helicidæ by Mr. Binney.

IX. The Philomycidæ have a "jaw with or without anterior ribs, and median projection or cutting edge," teeth distinguishable into central, lateral, and marginal; a mantle covering the whole body, and the shell entirely suppressed. Four species are found within our limits, all of which are referred to the genera Tebennophorus, although there are two quite distinct forms which seem to have been confounded in it. The names used by Professor Morse are Tebennophorus and Pallifera.

X. The Orthalicidæ are forms which have a peculiar jaw in that it is "thick, solid, composed of a median triangular piece, with base corresponding to upper margin of jaw, and near the apex of which converge on either side oblique imbricated plates, free below, adherent above." The teeth are distinguished into "central and lateral teeth with quadrangular base, with central cusp more or less obtuse, generally very much expanded, with rudimentary side cusps" and "marginal teeth quadrate, of same type;" the mantle is posterior and included, and the shell spiral and turreted. Two species are found in Florida belonging to the genera Orthalicus and Liguus.

XI. The Punctidæ include forms with the "jaw low, wide, slightly arcuate, with blunt, squarely truncated ends, "disintegrated into many" (about sixteen) "separate pieces, each higher than wide, with small overlapping edges;" the teeth are quite peculiar (but most like those of the Auriculidæ) and represented only by centrals and laterals having bases of attachment longer than wide, expanded below and squarely truncated, and free portions narrowed and reflected;" the mantle is submedian, and the shell heliciform. Not more than one species is certainly known within our limits. It is the Helix minutissima or Punctum minutissimum of most American authors, but it is regarded by Mr. Binney as being identical with a European species and called by him Microphysa pygmæa.

XII. The Succiniidæ have a jaw surmounted by an accessory quadrangular plate, teeth differentiated into (1) a central tricuspid, (2) lateral which are tricuspid or bicuspid, and (3) marginal of a quadrate form "with narrow base, multicuspid reflection, serrate by the splitting of the inner cusp into numerous denticles;" mantle more or less included in the shell, and the shell more or less developed, spiral, thin, and transparent. The North American species are all referred to the genus Succinea by Mr. Binney, and twenty-six species are recognized.

All of the forms now noticed belong to the group Monotremata (or Syntremata) as previously noted, and only four species belong to the remaining two families of Ditremata.

The Veronicellidæ have a "jaw slightly arcuate, with numerous vertical ribs;" teeth differentiated into (1) "centrals, narrow, unicuspid, with expanded sides," (2) "laterals large, obscurely tricuspid," and with "medium cusp sharp and long," and (3) "marginals with quadrate base short, triangular, unicuspid," and mantle not distinct from general integument;" the shell is entirely suppressed. Two species have been found in the United States, one in Florida and the other in California; both are terrestrial.

The Ouchidiidæ have the "jaw entirely smooth or lightly wrinkled," teeth differentiated into "central tooth, tricuspid lateral teeth, and marginals with quadrate base, razor-shaped," having the "base long and with cutting point narrow" and "medium cusp truncated and very long;" the mantle is "thick, more or less tuberculous above," and no shell is developed. The two North American species belong to the genus Onchidella, one (O. borealis) occurring from Prince William's Sound to Vancouver's Island, and the other (O. Carpenteri) from the Straits of Fuca to the Gulf of California.

Differences among the slugs.—Some of the European malacologists admit numerous species of Slugs as of the families Limacidæ and Arionidæ on slight differences of form, proportions, and coloration, but the propriety of so doing has been questioned by Mr. S. Jourdain, who thinks that the differences that have generally been made use of for specific distinctions vary with age as well as habitat. He therefore urges that investigation should be directed to the internal organs and especially to the arrangement of the generative apparatus. "The pedal gland is also of service; it contains a cylindrical excretory canal which extends more or less along the median line, and receives the mucoso-glandular secretions of the lobules of a racemose gland on either side of it; the internal face of the canal is vibratile. In the Limacidæ it arises as an invagination of the ectoderm, and subsequently becomes branched; the extremities of the branches are invested by mesodermic cells which rapidly become secretory." On differences discernible in the characters in question, Mr. Jourdain distinguishes five species occurring in the environs of St. Vaast-la-Hougue: these are four of the family Limacidæ and one of Arionidæ. (*Comptes Rendus*, Acad. Sci. v. 101, pp. 963–966. *J. R. M. S.* (3), v. 16, p. 50.)

An European Palæozoic land shell.—Until lately, no land shells have been found in the palæozoic rocks outside of North America, but in the western continent seven species have been found in Carboniferous and Devonian deposits—six in the former and one in the latter. During the past year however, Dr. Paul Fischer has described a species referable to the genus Dendropupa from a Permian deposit at Saône-et-Loire. The new species is related, in Dr. Fischer's opinion, to the first-discovered species of the genus Dendropupa (D. vetusta), found in the coal-joggins of Nova Scotia, but the form is different, and although larger, there are only seven (instead of nine) whorls. Only a single cast of the species was found in the midst of various vegetable remains. The form has been named Dendropupa Wolchiarum. (*Journ. de Conchyl.* (3), v. 25, pp. 99–105.)

Characteristics of Tectibranchiate Gastropods.—In the first part of a work devoted to zoological and anatomical researches on the Opisthobranchiate mollusks of the Gulf of Marseilles, Dr. A. Vayssière has treated of the Tectibranchiates. The memoir is valuable on account of the use made in it of characteristics which have hitherto been neglected. The author, with Dr. Fischer, divides the group into three divisions, named Cephalaspidea, Anaspidea, and Notaspidea. Besides much other information, details are given as to the food of various forms. Some are carnivorous, such as species of Scaphander, Philine, and Doridium; others are omnivorous, like Gastropteron and Pleurobranchus, and still others are completely herbivorous, as the sea-hares (Aplysia) and Notarchus. (*Recherches zoologiques et anatomiques sur les mollusques opisthobranches du Golfe de Marseilles*, 181 pp.; *Journ. de Conchyl.* (3), v. 25, pp. 206–209.)

Cephalopods.

Cartilages of Sepia.—The "cartilages occurring in the head of Sepia" have been examined by W. D. Haliburton. "The basis of the cartilage is a chordrin-like body, which gives the re-action of macen and gelatine. But the gelatinous element is exceedingly small and no gelatinization occurs on the cooling of the hot-water extract. The cartilage differs however from that of vertebrates in containing a small percentage of chitin." In *Sepia* the percentage is 1·22 per cent. (*Quart. Journ. Micr. Sc.*, v. 25, pp. 173–181; *J. R. M. S.* (2), v. 5, p. 222.)

PROTOCHORDATES.

Tunicates.

Relations of Tunicates.—An elaborate monograph of the genus *Doliolum* has been published by Dr. B. Uljanin as a contribution to the "Fauna und Flora des Golfes von Neapel (x, 1884), and in it are detailed the structural characteristics and the embryology. Various mooted questions as to the morphology and relationships of the group, as well as the Tunicates in general, are considered. The author inclines to the view that the Tunicates "represent a side branch of the vertebrate phylum, whose point of origin is near its root." The Apperdiculariids are "regarded as the most primitive representatives of the group; they give rise to the simple Ascidians; thence there branched off the Solpidœ on the one hand, and the compound Ascidians on the other; the latter gave rise to the social Ascidians, to *Botryllus* and to *Pyrosoma*, while the primitive stock was continued on through *Anchonia* to *Doliolum*." Of course these views are to a large extent hypothetical, and perhaps, or even quite likely, wrong in some details, but so far as they are legitimate deductions from a careful and detailed study, are valuable as well as suggestive for further investigation. (*J. R. M. S.* (2), v. 5, pp. 231–233.)

VERTEBRATES.

General.

The North American Fish Fauna.—The "Synopsis of the fishes of North America" by Profs. David S. Jordan and Charles S. Gilbert, published early in 1883, has been followed during the past year by a "Catalogue of the fishes known to inhabit the waters of North America north of the tropic of Cancer, with notes on the species discovered in 1883 and 1884," by Prof. David Starr Jordan. Since the publication of the synopsis, in 1883, "an active study of North American fishes has brought to light many species not included in the synopsis, and has shown various errors in the nomenclature of species already known. The additions are chiefly in the Bassalian or deep-sea fauna of the Atlantic, in the tropical fauna of the Florida Keys, and in the fresh-water fauna of the lower part of the Mississippi Valley," regions recently reexamined. Professor Jordan has also extended the range adopted in the synopsis so that the new catalogue represents "the present state of our knowledge of the fishes found north of the tropic of Cancer in American waters." In the new catalogue, 1,683 species are adopted, and in addition 187 subspecies are recognized, giving a total of 1,870 species and subspecies. These species are segregated under 587 genera and 157 families. Several of the comprehensive genera and families of the synopsis have been now disintegrated, more natural and better definable groups being recognized in their place. In a "recapitulation," an assignment of the species to the various faunas is made. In regard to many of them, such an assignment, in the words of Professor Jordan, is "simply arbitrary, and in this fact lies the chief element of error in the following list. Thus many Arctic shore fishes belong to the Bassalian fauna of New England, while many West Indian species occur northward, more or less frequently as far as Cape Cod." It must be added, too, that "no species is counted twice, but in each case of the numerous species which range over several faunal areas, each is referred to that area which is supposed to be most properly its home, or to that in which its occurrence has been longest known." The figures given by Professor Jordan are as follows:

	Species.
Bassalian or deep-sea fauna of the Atlantic	105
Arctic (Greenland) fauna	65
New England (Newfoundland to Cape Hatteras)	95
South Atlantic and Gulf coast (shore fauna)	140
West Indian fauna (including Florida Keys and "Snapper Banks," of Pensacola)	290
Tropical fauna of the Pacific (Gulf of California, southward)	240
California fauna (Cape Flattery to Cerros Island)	220
Alaska (Cape Flattery to Bering's Straits)	90
Pelagic species	35
Fresh waters: East of Rocky Mountains	465
Fresh waters: Between Rocky Mountains and Sierra Nevada (Great Basin, &c.)	75
Fresh waters: West of the Sierra Nevada and Cascade Range	50
Total	1,870

The Fishes of Tropical America.—After having elaborated all the species of fishes of temperate and arctic America, Prof. David S. Jordan addressed himself to a preparation of a list of the fishes found along the Pacific coast of tropical America from the Tropic of Cancer to Panama. The species of this region were almost unknown a quarter of a century ago, and, in the words of Professor Jordan, "our knowledge of these species is due chiefly to the studies of Dr. Gill, Dr. Günther, Dr. Steindachner, and Professors Jordan and Gilbert. Only a few collectors have given especial attention to the fish fauna of this region, but the work of these has, in nearly all cases, been of exceptional value. The earliest extensive collections were made by Mr. John Xantus at Cape San Lucas, and later at Colima. The specimens obtained by Xantus comprise especially the fishes of the rock pools. These were studied by Dr. Gill in 1862 and by Professor Gilbert and the writer in 1882." Since that early time, however, numerous other collectors have obtained fishes, and among the most prominent of these are Captain John M. Dow, Mr. Osbert Salvin, Dr. Franz Steindachner, Prof. Frank Bradley, Dr. Bocourt, and, last and greatest, Messrs. Jordan and Gilbert. Altogether 407 species have been obtained, and these represent 187 genera and 68 families. A comparison of these with the Caribbean and Gulf of Mexico fauna is interesting and instructive. According to Professor Jordan's identifications, 71 species, or 17½ per cent., are found also on the Atlantic coasts. If we add to this some 800 species now known from the Caribbean Sea and adjacent shores, we have about 6 per cent. of the whole number known, as common to the two coasts. This number, 71, is not very definitely ascertained, as there must be considerable difference of opinion as to the boundaries of species, and as several of these species regarded as common are open to doubt and need verification." Professor Jordan believes however that "fuller investigations will not increase the proportions of common species, and, if it does not, the two faunas show no greater resemblances than the similarity of physical conditions on the two sides would lead us to expect.

These conclusions contrast with those of Dr. Günther. "Dr. Günther assumes that nearly one-third of the total number of species of marine fishes on the two shores of tropical America will be found to be identical. Hence he infers that there must have been, at a comparatively recent date, a depression of the isthmus, producing an intermingling of the two faunas."

Professor Jordan explains that "this discrepancy arises from the comparatively limited representation of the two faunæ at the disposal of Dr. Günther. He enumerates 193 marine or brackish-water species, as found on the two coasts, 59 of which are regarded by him as specifically identical, this being 31 per cent. of the whole. But in 30 of these 59 cases" Professor Jordan regards "the assumption of complete identity as erroneous, so that, taking the number 193, as given," he would "reduce the percentage to 15. But these 193 species form but a fragment of the total fauna, and any conclusions based on such narrow data are certain to be misleading."

Some data respecting the supposed con-specific forms are interesting. "Of the 71 identical species admitted in our list, several (*e. g.*, *Mola*, *Orcynus*) are pelagic fishes, common to most warm seas; still others (*e. g.*, *Trachurus*, *Caranx*, *Diodon* sp.) are almost cosmopolitan in the tropical waters; most of the others (*e. g.*, *Gobius*, *Gerres*, *Centropomus*, *Galeichthys* sp., &c.) often ascend the rivers of the tropics, and we may account for their diffusion, perhaps, as we account for the dispersion of fresh-water fishes on the isthmus, on the supposition that they may have crossed from marsh to marsh at some time in the rainy season." But "in very few cases are representatives of any species from opposite sides of the isthmus exactly alike in all respects. These differences in some cases seem worthy of specific value, giving 'us representative species,' on the two sides. In other cases, the distinctions are very trivial, but in most cases they are appreciable, especially on fresh specimens."

Finally, Professor Jordan is "brought to the conclusion that the fish faunæ of the two shores of Central America are substantially distinct, so far as species are concerned, and that the resemblance between them is not so great as to necessitate the hypothesis of the recent existence of a channel across the isthmus, permitting the fishes to pass from one side to the other."

These results are especially noteworthy inasmuch as they confirm and are themselves corroborated by the results of studies of various other classes of the animal kingdom. (*Proc. U. S. Nat. Mus.*, v. 8, pp. 361–394.)

Selachians.

Classification of the Sharks.—An important contribution to our knowledge of the skeletons of sharks, and some excellent hints as to the classification of the group, have appeared in an article by Prof. William

A. Haswell, of Sydney, Australia, entitled "Studies on the Elasmobranch Skeleton." That naturalist examined the complete skeletons or skulls of 17 species of Selachians, and has described the essential peculiarities of the skull, visceral arches, shoulder girdle, pectoral fins, and pelvic fins, as well as dorsal, anal, and caudal. The results of his examinations are embodied in a summary in which he recapitulates the essential characters of the various families and including groups.

Professor Haswell recognizes for the plagiostomes generally two orders, the Selachoidea and the Batoidei, which are characterized as follows:

The Selachoidei are distinguished in that "in the skull the post-orbital processes are usually well developed; the orbit is usually provided with a cartilaginous floor formed of the basal plate; there is always a palato-basal articulation; the rostrum usually consists of three bars with large foramina at the base. There are a series of external branchial arches; the first branchial arch never articulates with the skull; the hyo-arch is supported by the hyo-mandibular; the copula of the hyoid has the form of a broad plate connected with its distal extremity. The pectoral fin is not connected with the skull by means of an ant-orbital cartilage; the ventral portion of the pectoral arch is divided in the middle by a more flexible portion into two lateral halves usually slightly movable on each other, and the dorsal extremities do not articulate with the spinal column. The pro- and meta-pterygia of the pectoral fin are never greatly elongated, and usually have the form of relatively broad plates."

The Batoidei are recognized as an order contrasted with the Selachoidei in the following terms: "The post-orbital processes are small or absent; the orbit is devoid of cartilaginous floor. There is no palato-basal articulation. The rostrum, when present, is usually imperforate at the base. There are no external branchial arches; the first branchial arch is sometimes directly connected by the hyo-mandibular with the skull. When the hyoid arch is supported by the hyo-mandibular the articulation takes place near the proximal extremity of the latter. The ventral portion of the pectoral arch forms a continuous rigid bar; the dorsal extremities of the arch are connected either with the spinal column or with one another. The pro- and meta-pterygia of the pectoral fins have the form of elongated narrow bars, and the mesopterygium is insignificant. The anterior portion of the pectoral fin is connected by a cartilage—the ant-orbital cartilage—with the ethmoidal region of the skull."

The Selachoidei, or sharks, are disintegrated into two "suborders," named Palæoselachii and Neoselachii. Professor Haswell considers this grouping to "follow as a necessary conclusion from the researches of Gegenbaur on the anatomy of the skull." The suborders are distinguished by the following characters:

In the Palæoselachii "the occipital region of the skull is not so sharply marked off from the spinal column as in other Elasmoranchii;

it presents above a mesial ridge continuous with the spinous processes and at the sides ridges continuous with the line of the transverse processes. The plane of the occipital region is vertical or inclined from below upwards and backwards. There is no lateral occipito-vertebral articulation. The principal vagus foramen is placed far from the foramen magnum; the lower roots of the nerve pass out by from three to five distinct canals which are in the line with the foramina for the spinal nerves. The vestibulum forms a distinct eminence on the surface of the infero-plateral portion of the auditory region. The articular surface for the hyo-mandibular is simple, and not sharply marked off from surrounding parts. The post-orbital process presents an articular surface for the palato-quadrate. The orbit has no cartilaginous floor. There is an ethmoidal canal. There is no tri-radiate rostrum. Representing the ant-orbital cartilage of rays is an ant-orbital process. There are either six or seven branchial arches; the external arches are incomplete. There is only one dorsal fin; its rays are supported by a broad basal cartilage."

In the Neoselachii "the centra of the vertebræ are well ossified. The occipital region is well marked off from the vertebral column. The plane of the foramen magnum is vertical or slopes forwards. The principal vagus foramen is usually approximated to the foramen magnum, and there is never a row of accessory foramina in line with the foramina of spinal nerves. There is no distinct elevation on the surface of the skull marking the position of the vestibule. The articular surface for the hyo-mandibular is complex. The post-orbital process never presents an articular surface for the palato-quadrate. The orbit has a cartilaginous floor. There is no process representing the ant-orbital cartilage of the rays. There are never more than five branchial arches. There are two dorsal fins, which may or may not present broad basal cartilages."

The suborder Palæoselachii is represented by only one family, the Notidanidæ, while the Neoselachii examined by Professor Haswell are differentiated by him into the families Cestraciontidæ, Lamnidæ, Scylliolamnidæ, Scyllidæ, Rhinidæ, and Pristiophoridæ.

Fishes or Teleostomes.

Pterospis and Scapbaspis.—In a Devonian bed in Galacian Podolia (Russian-Poland) were found two shields, one a *Pterospis* and the other a *Scapbaspis* united, and universily opposite each, and giving the impression that they were in natural union; the *Pterospis*, however, projected further forwards than the *Scapbaspis.* It has therefore been urged by Dr. A. Altb that the *Pterotpis* was the dorsal and the *Scaphaspis* the inferior buckler of the same fish. The mouth is thought to have been in the inter-space between the two shields and thus to have been somewhat inferior. (*Abhandl. Sitz. Ber. Akad. Krahan*, v. 11, pp. 160–187, pl. 6, *Archives Slaves de Biol.*, v. 1.)

The Burramundi.—One of the most interesting of all fishes is an inhabitant of certain Australian rivers, and is known to some of the English settlers of the country as the salmon and flathead; its native name is Burramundi. It has no resemblance whatever in form to the salmon and has been called so only because its flesh is pinkish like the salmon's. In shape it perhaps more resembles or rather has less dissimilarity to the fresh-water ophiocephalids of India or to a thick eel than to any common or well known fish. This resemblance results from its elongated subcylindrical form and the gradual tapering of its tail backward to the confluence of the dorsal, anal, and caudal fins. The head is depressed, wedge-shaped, and covered with a bony armature. The scales, which are almost confined to the body (although slightly encroaching upon the vertical fins), are large and have a peculiar structure. Its chief interest results from the fact that it is the representative of a family of fishes which is represented by numerous species in the secondary geological age in the northern hemisphere, and it was supposed, until 1870, to have become extinct at the end of the Triassic epoch. It was therefore a matter of the greatest astonishment to all naturalists when a species of the type was discovered living in the fresh waters of Southern Australia, and the living representative of the ancient family was found to be so nearly related to the extinct forms that it has been regarded by most naturalists as belonging to the typical genus Ceratodus. It exhibits however differences of dentition removing it from any of the extinct forms, and there is no evidence that the secondary species had a skeleton or scales generically similar to those of the living representatives; it has therefore by a few naturalists, been regarded as belonging to a peculiar generic type known as Neoceratodus. The ceratodonts are remarkable likewise on account of their nasal apertures opening into the palate, in which respect however they agree with two other living types of Dipnoous fishes, although differing from all others of the class except them. The assiduous researches of various naturalists have at length given us a tolerable insight into the life history of the Burramundi. It is confined to certain rivers of South Australia, and its headquarters seem to be in the Burnett River. Its mode of progression is by waves of the tail or by paddling with the pectoral fins without moving the posterior pair of fins or the tail. When at rest on the bottom of the tank the pectorals are placed nearly at right angles to the body while the hinder fins are brought nearly parallel to the tail. If not disturbed it will remain in this position for hours, and only when stirred up does it think it necessary to use the fins and tail at all. It then lurches out with the great strong tail turning sidewise and squeezes in between some tufts of grass. Professor Ramsey endeavored to urge it to make some progress in only afew inches of water, but, as far as he could experiment, without effect. The fish is exceedingly eel-like in its movements, and when going slowly along the swaying of the great caudal fin entails a serpentine course. It is the opinion of Professor Ramsey that the fish could not get forward in a straight line unless swimming very fast or very slowly at the time, and when it does this it does not use the tail at all, but depends upon the pectorals. The Neoceratodus has been said to frequently leave the water and go upon land, and the possession of fully developed lungs seems to warrant such a belief, but Professor Ramsey doubts whether it ever goes quite out of the water, as has been reported, for the simple reason that the fish is too bulky to progress by the fins, and not long enough in the body to go eel-fashion; at any rate, individuals in confinement decidedly objected to being kept any length of time out of water; they put up with it a few minutes and then began to plunge about so that he was always glad to get them back again in the water, fearing that they would injure themselves. As the cold weather approaches the Burramundi becomes inactive, and even too lazy to get out of the way when about to be handled.

The ovaries and testes are nearly developed, and in April, or the early antipodal fall, in the Burnett River, but not before the beginning of September, or at the commencement of spring in the southern hemisphere, have the eggs been found laid in the water. They are deposited among the weeds and are placed each one by itself, "resembling those of the common newt" or salamander. They are fertilized in the water like those of some species of the newt kind. They are very difficult to be obtained. Mr. Caldwell spent many weeks hunting and, with the assistance of the blacks, turned up many hundred water-holes before he found any eggs. These were "covered with an enormous quantity of gelatinous matter which required some special means to remove," and it was "eight days before he got a single egg out whole. When he succeeded in getting at the early stages, it remained to rear them until they were practically identical with the adult fish. This was a very difficult task, as the enemies of the Ceratodus were very numerous. There were two kinds of fungi which attacked the eggs. He put in crustacea to devour the fungus, but these in turn attacked the young fish when it emerged from the egg. He was three months, till near the end of November (or the end of the Australian spring), developing the eggs." It is also noteworthy that not until nearly six weeks after hatching were the hind limbs developed in the young. The egg of the Ceratodus undergoes "a complete segmentation similar to that of the kangaroo." (Caldwell in *Journ. Royal Soc. N. S. Wales*, v. 18, pp. 119, 120.)

The extent of Salmon Leaps.—Observations have been made by Prof. A. Landmark, the chief director of the Norwegian fisheries, on the extent of the leaps which salmon are capable of. He thinks that "the jump depends as much on the height of the fall as on the currents below it. If there be a deep pool right under the fall, where the water is comparatively quiet, a salmon may jump 16 feet perpendicularly; but such jumps are rare, and he can only state that it has taken place at the Hellefos, in the Drams River, at Haugsend, where two great masts have been placed across the river for the study of the habits of the salmon, so that exact measurements may be effected. The height of the water in the river of course varies, but it is, as a rule, when the salmon is running up stream, 16 feet below these masts. The distance between the two is 3½ feet, and the professor states that he has seen salmon jump from the river below across *both* masts." As another example of high jumping, he refers to the Carritunk waterfall, in the Kenebec River (Maine), "where jumps of 12 feet have been recorded. Professor Landmark further states that when a salmon jumps a fall nearly perpendicular in shape it is sometimes able to remain in the fall, even if the jump is a foot or two short of the actual height. This, he maintains, has been proved by an overwhelming quantity of evidence. The fish may then be seen to stand for a minute or two a foot or so below the edge of the fall in the same spot, in a trembling motion, when, with a smart twitch of the tail, the rest of the fall is cleared. But only fish which strike the fall straight with the snout are able to remain in the falling mass of water; if it is struck obliquely, the fish is carried back into the stream below. This Professor Landmark believes to be the explanation of salmon passing falls with a clear descent of 16 feet." He thinks that this is the extreme jump the salmon is capable of, and indicates that of course not all are capable of performing such a feat. (*Nature*, v. 32, pp. 329, 330.)

A peculiar Mullet. A remarkable type of lower jaw.—A new generic type of mullet, the family Mugilidæ, has been described by Mr. W. Macleay, which is noteworthy on account of the anomalous mode of articulation of the lower jaw, and concomitant modifications of the neighboring parts. The new type was found very abundantly in the Goldie River of New Guinea, "about 100 miles, by its course, from its mouth," and was found to be "excellent" as a food-fish. The aspect of the entire fish was not unlike that of other members of its family, but in the inferior surface of the head differences from all others were well marked. As Mr. Macleay remarks, "in most teleosteous fishes, at all events in this family, the gill openings are large, and what may be termed the gill covers extend quite to the symphysis of the lower jaw, leaving a more or less open space on the chin composed of the integuments surrounding the extremity of the hyoid arch, and forming the floor of the mouth." In the new form a transverse fissure or groove appears behind the lower jaw, and when the integuments are removed some remarkable peculiarities are unveiled. "The chief and most obvious peculiarity" is "undoubtedly the well-marked division across the under surface of the head, from the extremity of the ramus of the mandible on one side to that of the other, a division however which though deep and well defined, is only external and has no communication with the mouth. An examination of the bones of the head shows however that notwithstanding the very abnormal external appearance, the actual divergence from the typical fish skull is less than might have been anticipated, and in fact is not so much a divergence from the type as a variation of it."

"The hyoid bones are the least normal; the urohyal is slight; the basihyal short, and the glossohyal very small and slightly longer than broad. The most advanced of these bones, the glossohyal, reaches only to the transverse division at the base of the mandibles, whereas in Mugil waigiensis [or any other mullet] the basihyal and glossohyal bones are large and prominent, supporting the whole floor of the mouth and extending almost to the symphysis of the lower jaw."

The new form has been named Æschrychtys Goldiei. Good-sized specimens are 18 inches in length. (*Proc. Linn. Soc., N. S. Wales*, v. 8, pp. 2–6.)

The nest of the fifteen-spined Stickleback.—Like all the other species of the family Gasterosteidæ, the fifteen-spined or salt-water stickleback builds a nest attached to certain plants, which is much like those of its congeners, but some additional information has been communicated by Professor K. Mobius respecting the constitution of the threads by which it interweaves the particles constituting its nest, and the origin of those threads. An examination of male sticklebacks, in May and June, 1884, demonstrated to him that the threads are generally from 0·12^{mm} to 0·13^{mm} in diameter, and consist of several cords stuck together, and which again are composed of very fine parallel threads. The substance of which they are composed is nitrogenous, and is a peculiar modification of mucine as appears by its behavior towards various acids and alkalies. It is formed in the kidneys of the male, and indeed in the epithelial cells of the urinary canals, which exert this form of activity only at the time of reproduction, and during this period it behaves towards staining re-agents in the same way as the muciferous organs of other vertebrata. (*Schriften natur-Vereins f. Schleswig-Holstein*, v. 6; *Ann. & Mag. Nat. Hist.* (5), v. 16, p. 153.)

A tropical Gunnel Fish.—The family of Murænoidids or Xiphidiontids had been supposed to be a characteristic cold-water type. All the previously known species were confined to the seas of the temperate and north polar regions until the discovery had been made of a species of the family representing a peculiar genus occurring at Key West, Fla. The species has been named Stathmonotus Hemphilii by Dr. Bean, the curator of fishes in the U. S. National Museum. Most of the characteristics of the new generic type are shared with the common gunnels or species of Murænoides, but it has no scales; moreover, on one hand, the pectorals are much smaller, and on the other the ventrals are better developed than in Murænoides, their position is more anterior, and a spine and two rays of moderate size exist. (*Proc. U. S. Nat. Mus.* v. 8, pp. 192, 192.)

The American Flying Fishes.—The fishes of the sub-family of Exocœtines, including the true flying fishes, have been examined recently by Messrs. Jordon and Meek, and it appears that seventeen species referable to four genera are recognizable as inhabitants of the American waters on both sides of the continent. Three of these, *Fodiator acutus*, *Parexocœtus mesogaster*, and *Halocypselus evolans*, belong to special genera, while all of the others are members of one natural genus (Exocœtus). Eight of the Exocœtines have been obtained off the Atlantic coast of the United States and one (*Exocœtus Californicus*) along the Pacific coast. The California flying fish is one of the largest of the family. (*Proc. U. S. Nat. Mus.*, v, 8, pp. 67.)

Amphibians.

The Retrograde Metamorphosis of Siren.—The remarkable eel-like amphibian named Siren lacertina, and abundant in the southern parts of the United States, is the type of a group, by some considered as an order, distinguished by some remarkable characteristics; some of these have been considered to be evidences of degeneration. Professor Cope has now reason to believe that there are also indications to be found of "a retrograde metamorphosis" in the "history of its branchial apparatus." He had been at a loss to account for the curious condition frequently observed in the branchiæ of the sirens. The fringes are frequently partially atrophied and "inclosed in a common dermal investment of the branchial ramus, or all the rami are covered by a common investment, so as to be completely functionless and immovable. This character, observed in the *Pseudobranchus striatus*, gave origin to its separation from the genus Siren." The character is however also observable in the typical species, *Siren lacertina*, at a certain age, and the real difference, so far as generic valuation is concerned, depends simply on the different number of the digits represented in the two species.

Professor Cope surprised "on discovering that the functionless condition of the branchiæ is universal in young individuals of *Siren lacertina* of 5 and 6 inches in length;" and even in a specimen little more 3 inches long they were found "entirely rudimentary and sub-epidermal;" in fact, according to Professor Cope, only in large adult specimens are the branchiæ fully developed. The inference drawn from the facts is, that "the branchiæ are in the Sirens not a larval character, as in other perennibrachiate Batrachia, but a character of maturity. Of course, only direct observation can show whether Sirens have branchiæ on exclusion from the egg; but it is not probable that they differ so much from the other members of their class as to be without them. Nevertheless, it is evident that the branchiæ soon become functionless, so that the animal is almost, if not exclusively, an air breather, and that functional activity is not resumed till a more advanced age." Indeed, from observations of a specimen in an aquarium, which for a time had no branchiæ at all, it appeared that "sirens may be exclusively air breathers." Professor Cope urges that in explanation of this fact, it may be remarked that this atrophy cannot be accounted for on the supposition that it is seasonal and due to the drying up of the aquatic habitat of the sirens. The countries they inhabit are humid, receiving the heaviest rainfall of our Eastern States, and there is no dry season. The only explanation appears [to him] to be that the present sirens are descendants of a terrestrial type of batrachia which passed through a metamorphosis like other members of their class, but that more recently they have adopted a permanent aquatic life, and have resumed their branchiæ by reversion." (*Am. Nat.*, v. 20, pp. 1226, 1227.)

Peculiarities of Cœcilians.—The life history of the singular worm-like Amphitrans, representing the order Gymnophiona and the family Cæcibiidæ, is still imperfectly known. Some characteristics have been described recently by the brothers P. B. and C. F. Sarason. In an advanced stage, shortly before hatching, the embryo is provided with very long blood red external gill filaments, and has also a distinct tail, with a strong fin. The gill filaments are shed previous to hatching, after which the young Cæcilians make their way to a neighboring stream, in which they breathe by means of gill slits. After they leave the water their gill slits close up, and they breathe by lungs. There is a fourth gill arch from which the pulmonary artery is given off. The spermatazoon has a spiral filament. The last two facts tend to show that the Cæcilians were nearer to the Modela than to the Anura, as is indeed amply shown to be the case by structural characteristics generally. It seems that there is a difference in reproduction manifested in closely related genera, for some species are oviparous while others are viviparous.

Reptiles.

The classification of the Lizards.—A very important and much needed work has been in progress of publication during the past year in the arrangement and description of the species of living lizards. Two volumes of the projected three of the "Catalogue of Lizards in the British Museum" have already appeared, in which all the species known are described and a number illustrated. The species have been thoroughly revised from a systematic standpoint and grouped into natural genera and families. The classification is mostly based upon such characters as were made use of by Professor Cope about twenty years ago, but which have not received due consideration from later writers. Professor

Cope's work upon the group is indeed the only contribution to the taxonomy of the lizards that is esteemed of special value by the author of the new catalogue. That author is the well-known herpetologist in charge of the reptiles of the British Museum, Mr. George Alfred Boulenger. Mr. Boulenger, however, by no means follows Professor Cope throughout, but has his own well considered views as to the value of the characters first brought prominently forward by Professor Cope. He accepts the order of Lacertians with the limit generally accredited to it of late years, and thus excludes the Sphenontidæ or Hatterüdæ. The order is subdivided into two sub-orders: (1) the Lacertilia vera; (2) the Rhiptoglossa. The several sub-orders into which the former have been disintegrated by Professor Cope are not recognized and even the families have in some cases been separated, by the intervention of groups adopted by Professor Cope. Twenty-one families of the order are adopted by Mr. Boulenger, and it is interesting to note that three of these were entirely unknown to Duméril and Bibron when, in 1836 to 1839, they published those volumes of their great work devoted to the order.

The following tabular synopsis of the characters most made use of by Mr. Boulenger will give an idea of the range of variation and systematic values of the various characters. The external form is found to be not only of very little use, in many cases, in the determination of the relations of the types, but sometimes it is very illusive indeed.

The characters utilized for the diagnosis of the various families are almost exclusively derived from the skeleton and teeth, and especially from the consideration of the following elements:

1. The development or non-development of a post-frontal arch (*Postfr.*).

2. The development or non-development of a post-orbital arch (*Post-orb.*).

3. The development or otherwise of a supra-temporal roof (*Suprat. roof*).

4. The existence or absence of a columella crani (*Col. cr.*).

5. The development or non-development of an inter-orbital septum (*I. O. s.*).

6. The number of parietal bones, *i. e.*, whether paired or single (*Par.*).

7. The number of frontal bones, whether double or coalesced (*Fr.*).

8. The number of nasal bones, *i. e.*, whether two or one (*Nasals*).

9. The number of pre-maxillary bones, *i. e.*, whether one or two pairs (*P. max.*).

10. The number of elements in each ramus of the lower jaw or mandible, *i. e.*, whether four or five (*Mand.*).

The teeth, especially whether implanted along the edge of the jaws (acrodent) or on the inner slope (pleurodent) (*Teeth*).

12. The development of inter-clavicles, *i. e.*, whether "dilated" and "loop shaped proximally," or whether "not dilated proximally" and cruciform (*X*). Of course in forms whose fore limbs are absent or very much reduced, the inter-clavicles are wanting.

	Postfr.	Postorb.	Suprat. roof.	Col. cr.	I. O.s.	Par.	Fr.	Nasals.	P. max.	Mand.	Teeth.	Int. cl.
Geckonidæ	0	0	0 (×)	×	....	2	2 or 1	2	....	5	Pleur ...	2 d
Eublepharidæ	0	0	0	×	....	1	2?	2	....	....	..do	....
Uroplatidæ	0	0 (1)	......	....	....	2	1	....	1	....	....	Minute.
Pygopodidæ	0	0	0	....	....	1 (2)	(1 ex. oz.)	....	1	4	Pleur ...	....
Agamidæ	×	×	0	×	....	1	1	...	1	....	Acrod.	×
Ignanidæ	×	×	0	×	....	1	1	....	1	....	Pleur.	× (—)
Xenosauridæ	×	×	0	....	....	1	1	2	1	....	..do	2 ×
Zonuridæ	×	×	×	....	....	1	1	2	1	....	..do	2 ×
Anguidæ	×	×	×	....	....	1	1 (2)	2	1	....	Var.....	2 × (0)
Aniellidæ	0	0	0	0	0	1	(2 ex. oz.)	2	1	....	Fangs ..	1 (?)
Helodermatidæ	0	×	0	....	....	1	(2 ex. oz.)	2	1	....	..do	×
Varanidæ	×	0	0	....	....	1	2	1	1	....	....	1 ×
Xantusüdæ	×	×	×	....	....	2	2	2	1	....	Pleur ...	2 ×
Teiidæ	×	×	0	....	var.	1	1	2	1	....	Var. sol.	2 ×
Amphisbænidæ	0	0	0	0	0	1	2	2	1	....	Var.....	2 0 (r)
Lacertidæ	×	×	×	....	....	......	....	....	1	....	....	....
Gerrhosauridæ	×	×	×	....	....	......	....	....	1	....	....	....
Scincidæ	×	×	......	....	....	......	....	....	2	....	....	....
Anelytropidæ	0	0	......	....	....	......	....	....	1	....	....	....
Dibamidæ	0	0	......	0	0	......	....	....	2	....	....	....

Throwing these characters into diagnostic forms, economy of words and a better idea of the generality of characters may be obtained by recognizing a category called super-family. Under such headings those forms which exhibit exceptional characters may be segregated from the great mass.

The various families recognized by Dr. Boulenger may be found grouped as follows:

Geckonoidea.—Eriglossate saurians with the vertebræ bi-concave, a clavical dilated, and loop-shaped proximally, and post-frontal and post-orbital osseus arches undeveloped.

(*Geckonidæ.*)—The only Geckonoidea known having the parietal bones double.

Eublepharoidea.—Eriglossate saurians with concavo-convex vertebræ, clavicle dilated and loop-shaped proximally, and no post-orbital or post-frontal squamosal arches.

(*Eublepharidæ.*)—The only known Eublepharoidea simulating in external appearance the Geckonidæ, but distinguished by the coalescence of the parietals into a single bone, as well as by the concavo-convex vertebræ.

Uroplatoidea.—Eriglossate saurians with bi-concave vertebræ, clavicles not dilated proximally, and without post-orbital or post-fronto squamosal bony arches.

(*Uroplatidæ.*)—The only known Uroplatoidea having two parietal bones and a minute inter-clavicle.

Pygopodoidea.—Eriglossate saurians with concavo-convex vertebræ, clavicles dilated and loop-shaped proximally, and no post-orbital or post-fronto squamosal arches.

(*Pygopodidæ.*)—The only known Pygopodoidea, especially marked by the exclusion of the frontal from the orbit, by the retention of the pre and post-frontal bones towards each other so that they are in contact.

Agamoidea.—Eriglossate saurians with concavo-convex vertebræ, clavicles not dilated proximally, and without post-orbital or post-frontal squamosal arches.

(*Agamidæ.*)—Agamoidea with the supra-temporal fossa not roofed over by bone, tongue thickened, and aerodont dentition.

(*Iguanidæ.*)—Agamoidea with the supra-temporal fossa not roofed over by bone, tongue thickened, and a pleurodont dentition.

(*Xenosauridæ.*)—Agamoidea with the supra-temporal fossa not roofed over by bone, the interior portion of the tongue retractile, a pleurodont dentition, and T-shaped inter-clavicles.

(*Zonuridæ.*)—Agamoidea with the supra-temporal fossa roofed over, the tongue simple, and cross-shaped inter-clavicles.

(*Anguidæ.*)—Agamoidea with the supra-temporal fossa roofed over; tongue with its anterior portion retractile, with clavicles cross-shaped or absent, and the exo-skeleton developed as osteo-dermal plates, each provided with a system of irregularly arranged aborescent or radiating tubules.

Anielloidea.—Eriglossate saurians, with concavo-convex vertebræ, clavicles not dilated posteriorly, and without post-frontal squamosal or post-orbital arches.

(*Aniellidæ.*)—The only known anielloidea, distinguished by the absence of ante-orbital septum, and of the columella cranii, and without squamosals.

Helodermatoidea.—Eriglossate saurians with concavo-convex vertebræ; clavicles undilated proximally, and post-orbital bony arches, but without post-fronto squamosal arches.

(*Helodermatidæ.*)—The only known family of the super-family, distinguished further by the exclusion of the frontal from the orbit on account of the convergence and contact of the pre and post-frontals.

Varanoidea.—Eriglossate saurians, with concavo-convex vertebræ; clavicles not delated proximally; post-orbital arches, rudimentary or absent, and with post-fronto squamosal arches developed.

(*Varanidæ.*)—The only known forms of the type, distinguished further by the union of the nasals into a single bone and the ensheathment of the tongue at its base and its deeply bifid emargination anteriorly.

Lacertoidea.—Eriglossate saurians with the vertebræ concavo-convex; clavicles undilated proximally, and post-fronto squamosal at post-orbital arches developed.

(*Xantusiidæ.*)—Lacertoidea with the supra-temporal fossa roofed over and the parietals distinct.

(*Teiidæ.*)—Lacertoidea with the supra-temporal fossa not roofed over and the parietals united into one, and without osteo-dermal plates.

(*Lacertidæ.*)—Lacertoidea with the supra-temporal fossa roofed over; the parietal bones united; the premaxillaries simple, single, and without osteo-dermal plates.

(*Gerrhosauridæ.*)—Lacertoidea with the supra-temporal fossa roofed over; parietal bones united; premaxillaries single, and with osteo-dermal plates, each provided with a regular system of tubules (or transverse ones anastomosing with longitudinal ones).

(*Scincidæ.*)—Lacertoidea with the supra-temporal fossa roofed over; the parietals joined, and with osteo-dermal plates, as in the Gerrhosauridæ.

Anelytropoidea.—Eriglossate saurians with the vertebræ concavo-convex; the clavicles not dilated proximally, and without post-fronto squamosal or post-orbital arches.

(*Anelytropidæ.*)—Anelytropoidea with the premaxillaries single, and without osteo-dermal plates.

Doubtful super-family. (*Dibamidæ.*)—Anelytropoidea, with the premaxillaries double and without osteo-dermal plates.

All the preceding twenty families are combined in the suborder "Lacertilia vera" (which may be better called Eriglossa), and are distinguished by the "nasal bones entering the border of the nasal apertures; pterygoid in contact with the quadrate; clavicle present whenever the limbs are developed [and the] tongue flattened."

The only remaining group or family of the order is that of the *Chamæleontidæ*, which represents alone the suborder "Rhiptoglossa," distinguished by the "nasal bones not bounding the nasal apertures, pterygoid not reaching quadrate; clavicle absent; limbs well developed, [and] tongue vermiform [and] projectile."

The geographical distribution of Lizards.—Much difference is exhibited by the associations of diverse animal groups in faunal areas. If, for example, we compare the distribution of fishes and birds, it will be found that the major groups into which they are combined are very different. The birds have accommodated themselves (to a large extent) to the present lay of the lands, while the fishes are distributed in such a manner as to convey the impression that the distribution has been determined by previous geological conditions and relations of the continents. Dr. G. A. Boulenger has recently given the outlines of the geographical distribution of the Lacertilians, or lizards, and has called attention to the very great difference between their distribution and that of other groups of reptiles, as well as that of the Batrachians or Amphibians. "If," says Dr. Boulenger, "we attempt to divide the globe as to its Batrachian fauna, two primary divisions present themselves, viz. a northern zone, comprising the Palæarctic and Nearctic regions, and an equatorial southern zone; but for lizards we have to draw a line from pole to pole, forming the Old World and Australia on the one hand, and America on the other, into primary divisions." The families of lizards recognized by him are thrown into two great groups,—(A) "small families having a narrow range," and (B) "large and much more widely distributed families." Ten belong to one of these groups and eight to the other, distributed as follows:

A. Uroplatidæ, Madagascar.
  Pygopodidæ, Australia.
  Xenosauridæ, Central America.
  Zonuridæ, South Africa and Madagascar.
  Aniellidæ, California.
  Helerdermatidæ, Mexico.
  Xantusiidæ, California, Central America, and Cuba.
  Gerrhosauridæ, Africa and Madagascar.
  Anelytropidæ, Africa.
  Dibamidæ, New Guinea.

B. Agamidæ. Most abundantly represented in the East Indies, less so in Australia, still less in Africa and Asia north of the Himalayas; absent from Madagascar and New Zealand.
  Iguanidæ. America. Two genera in Madagascar, and another in the Fiji Islands.
  Anguidæ. The bulk of this family occupies Central America and the West Indies, spreading to North and South America. One genus (*Anguis*) in Europe and the Mediterranean district, another (*Pseudopus*) represented by one species in the Mediterranean district and one in the Khasia Hills.
  Varanidæ. Africa (excluding Madagascar), Oriential region to Asia Minor, Australia.
  Teiidæ. America.
  Amphisbænidæ. Tropical and subtropical America (excluding Madagascar), and the Mediterranean region.
  Lacertidæ. Africa (excluding Madagascar), Europe, Asia; few in the East Indies.
  Chamæleontidæ. Africa (most abundant in Madagascar); one species, identical with a North African, extending to India and Ceylon.

As will be thus seen, the families enumerated are dispersed much in the same way as the birds, and in accord with the geographical division of the continents into the Old World and the New World, or, as they are termed by Mr. Boulenger, the "palæogean and neogean realms." According to Mr. Boulenger, "the latter is characterized by the presence of the Iguanidæ, Teiidæ, and abundance of Anguidæ; the former by Agamidæ, Varanidæ, Lacertidæ, and Chamæleontidæ. This division is the more natural, as we find in both realms, within their respective families, a repetition of the same forms having adapted themselves to similar conditions. Few more striking examples of parallel series of forms can be found than the families Agamidæ and Iguanidæ, or the Lacertidæ and Teiidæ. Such parallel series occur in almost every division of the animal kingdom; among the Batrachia we have the Arcifera and the Firmisternia; among the Chelonia, the Cryptodira and the Pleurodira; and there can be no doubt that the indications furnished by the range of such analogous large groups are of the greatest importance in tracing the relationships of the faunas of the various parts of the world."

It also appears, on proceeding to further subdivision, that "the Ethiopian and Oriental or Indian regions, which in their Batrachians are so closely related, have little in common as regards lizards; whilst, on the contrary, the Oriental and Australian, (so widely different in their Batrachians,) are extremely similar. We find also that the Palæarctic or Europæo-Asiatic, (the Batrachian fauna of which is so well characterized, and without any affinity whatever to the Ethiopian,) bears the closest resemblance to the latter region, differing only in the absence of various types which flourish in the tropical and sub-tropical zones."

In fine, according to Mr. Boulenger, "we arrive at the conclusion that the zoo-geographical regions generally in use, and especially their degree of relationship to one another, receive little support from the study of the distribution of the lizards; that the distribution in zones, which is so satisfactorily shown by the Batrachians and the fresh-water fishes, is contrary to the plainest evidence as regards lizards, which at the present time range more according to longitude; that the two great divisions originally proposed by Mr. Sclater, and derived from the study of passerine birds, hold good; and that if a division of the world had to be framed according to the lizard faunas, the primary divisions would be the following:

"I. *Palæogean realm.*—Two regions: 1. *Occidental* (=Palæarctic region, excluding the Manchurian subregion + Ethiopian region of Wallace); 2. *Oriental* (=Oriental + Australian regions of Wallace).

"II. *Neogean realm.—Nearctic + Neotropical regions.*"

The faunawhich especially interests Americans—that of the Neogean realm—may be briefly considered in the words of Mr. Boulenger. That fauna is "very uniform as regards groups of higher rank, and the changes from the center towards the north and south are very gradual. And it is noteworthy that the Central American fauna (of which the North American is but an offshoot) presents a greater variety of types than the South American; thus it possesses representatives of every one of the eleven families which occur in the realm, viz: Geckonidæ, Eublepharidæ, Iguanidæ, Xenosauridæ, Anguidæ, Aniellidæ, Helodermatidæ, Xantusiidæ, Teiidæ, Amphisbænidæ, and Scincidæ; whereas South America lacks the small groups Eublepharidæ, Xenosauridæ, Aniellidæ, Helodermatidæ, and Xantusiidæ. As the greater abundance and variety of forms of the Anguidæ occurs in the northern half and the West Indies, and the reverse is the case as regards the Teiidæ (especially with reference to variety of genera) and the Amphisbænidæ, we may safely draw the boundary line between two regions or sub-regions, as it may be thought fit to term them, at the Isthmus of Panama, the West Indies being comprised with the northern region. Lizards range only as far north as British Columbia (*Gerrhonotus cæruleus*), Minnesota (*Eumeces septentrionalis*), and Massachusetts (*Eumeces fasciatus*); whilst they have penetrated to the straits of Magellan (*Liolæmus magallenicus*)."—(*Ann. & Mag. Nat. Hist.* (5), v. 16, pp. 77–85.)

The contrast offered by the lizards to the fishes is marked, but not in the manner indicated by Dr. Boulenger. The fresh-water fishes are not distributed "in zones," but in quite a peculiar manner, although so complicated as to have given rise to the different interpretations of facts, of which Mr. Boulenger's (originating with Dr. Günther) is one expression. The regions of Sclater and Wallace, so far as the fishes are concerned, are rather grouped as follows:

I. *Cenogœan hemisphere.*—Three regions: 1. *Nearctic;* 2. *Palæarctic;* 3. *Oriental.*

II. *Eogœan hemisphere.*—Three regions: 1. *Ethiopian;* 2. *Neotropical;* 3. *Australian.*

Biped progression in a lizard.

A singular lizard of the family of the Agamids, having a frill-like development of the integument on each side of the head and neck confluent below, is found in Northern and Western Australia. It has a compressed body and a roundish tail, forming about two-thirds of the entire length, which amounts to between two and three feet. Its name is Chlamydosaurus Kingii, or the fringed lizard.

It seems, from observation by Mr. Charles W. De Vis, that this lizard is capable, to a limited extent, of a biped method of locomotion. On two occasions individuals were observed to adopt this method of progression, "trotting out briskly" on the hind limbs and with the "fore paws hanging down," so as to give the idea of affectation to the observer. The "vertebral line to the very snout" was "stiffened at an angle of 60 degrees;" the animal at length halted abruptly, erected its frill, and at the same moment turned its head inquiringly from side to side; then trotted on again for 20 yards or so, and, repeating its attitude of attention, continued in this course until it reached a tree it was making for; when this was reached it darted up the trunk and clung there immovable for a long time, or, in the words of Mr. De Vis, "for more hours" than his "leisure could afford for observation." The listening attitude was "so real, or at least so realistic," that it appeared to Mr. De Vis that "one function of the hood might be that of conducting sound to the tympanum, an office apparently aided by the channels formed by its converging folds, and that if it were so it might be furnished with special muscles." Another subject of inquiry suggested by the animal was the muscular furniture and other modifications of structure exhibited by the hind limbs. An investigation of the myology was therefore instituted. The result of this investigation was, on the whole, "somewhat disappointing" to Mr. De Vis.

The frill was found to be "served by special, though feeble, muscles, as well as by a large extension of the functions of some ordinary ones." The muscles "specialized for the purpose of assisting in the elevation and depression of the hood do not of themselves indicate very clearly that the appendage is in a strict sense an auditory conch. But since they certainly forbid the idea generated by the presence of the cartilage and by the observed actions of the animal, that the hood may serve to arrest sound and direct it toward the ear, we may, if we can overcome our disinclination to attribute an auricle to a reptile, recognize this as part of its office, without prejudice to its supposed use as an engine of terror to assailants."

The modifications of the hind limbs were not as great as might be naturally supposed, although Mr. De Vis thought that he might "fairly be allowed an expression of surprise on finding that the semi-erect attitude and plantigrade gait of the creature are not facilitated by any additions or modifications in the hind quarters and limbs." No essential differences from ordinary lizards are apparent. "The possibility of raising the body on the legs is rather permitted by circumstances generally favorable than brought about by direct means. It is in the comparative shortness and lightness of the head and anterior part of the trunk; the length without undue weakness of the hind limb; above all," as it appeared to Mr. De Vis, "the imperfect isolation of the several muscles, which enables them to act in certain directions with combined strength, that we must find an explanation of the power possessed by this lizard of simulating the gait of a cursorial bird." (*Proc. Linn. Soc. N. S. Wales*, v. 8, pp. 300–320.)

Birds.

Important collections in the British Museum.—Two extremely important and rich collections of bird-skins have been given to the British Museum by their owners; one especially devoted to American species, and the other to Indian forms.

The American collection was the result of collections during a number of years by Messrs. Osbert Salvin and Frederick Du Cane Godman, of London, and contained "upwards of 20,000 specimens." Many types of formerly "new species" are in the collection, and numerous memoirs, as well as the ornithological portion of the "Biologia Centrali-Americana," have been based on its contents, and, indeed, the specimens belonging to the families not yet studied for the latter work are reserved by the authors till their examinations shall be finished. There is said to be "a stipulation in the terms of gift that any specimen required by the donors may be removed on loan from the museum during the lifetime of the donors or the survivor of them." (*Ibis*, (5,) v. 3, p. 236.)

The Indian collection is due to the unsparing efforts and expenditures of Mr. Allen O. Hume, an Indian government officer, and contained not less than "63,000 birds," besides "18,500 eggs" and "500 nests." The sum of £300 was appropriated by the English Government for "packing and transmitting from Simla to England a part of Mr. Hume's collection of Indian birds, presented by him to the trustees" of the museum. Mr. R. B. Sharpe, the curator of the ornithological section of the museum, "started for Simla the end of April to superintend the packing of the collection," and was absent several months. Mr. Sharpe has good reason for thinking that "it is not too much to affirm that such a private collection as Mr. Hume's is not likely to be formed again, for it is doubtful if such a combination of genius for organization with energy for the completion of so great a scheme, and the scientific knowledge requisite for its proper development, will again be combined in a single individual."

The ornithological department of the British Museum, previously ahead of all competitors, has, by these acquisitions, become incomparably richer. (*Ibis* (5), v. 3, pp. 236, 334, 335, 456–462.)

Nesting of a Woodpecker.—Interesting observations have been made on the nesting of the brown woodpecker, scientifically known as Micropternus phæoceps, by Mr. Charles Bingham, deputy conservator of the forests of British Burmah. While passing through the Meplay forest reserve, he startled a woodpecker from a small pyingado tree (*Xylia dolabriformis*). Looking up into the branches, he saw "a large ants' nest, in the center of which appeared a circular hole so exactly like the borings made by woodpeckers ordinarily in the trunks of trees," that he sent up a Karen boy, who was with him, "to ascertain whether it was possible the Micropternus had been boring into the ants' nest," as he "had heard was the bird's curious habit. The ants' nest was only about 10 feet above the ground, placed in a fork of the pyingado, two small branches of which passed clean through it. Climbing up, putting in his fingers and then a twig," the boy "announced that there were two eggs." Leaving the nest alone for the time being, in the evening Mr. Bingham returned by the same route, and he was "able not only to cut off and carry into camp the whole nest as it was," but he "managed to secure also the hen bird as she flew from the eggs." Arrived at camp, he "got the two eggs out, and then very carefully made a cross-section through the ants' nest so as to divide the boring made by the woodpecker longitudinally." The ants' nest was "a large, spherical, solid mass of leaves and clay, the leaves outside being arranged one over the other something like the tiles on the roof of a house, but riddled in many places with the entrance tunnels made by the ant, a small black and red species of Myrmica." "Very few of the ants remained in the nest, and the few that were about seemed agitated and stung virulently. Probably the mass of them had been driven off or eaten by the woodpeckers. The tunnel the latter had made was about two inches in diameter and four inches long, bored horizontally in, and ending in an irregular-shaped egg-chamber about ten and a half inches in cross-diameter, but narrowed by the branch of pyingado, which pierced the nest through and through and crossed the egg-chamber diagonally. The bottom of this chamber alone was smooth, but there was no lining, and the two translucent white eggs of the woodpecker had rested on the bare boards, so to speak, of the ants' house. In the excavations made by the ants themselves there were neither eggs, larvæ, nor pupæ; probably these all had been removed when the woodpeckers invaded the nest." (*Nature*, vol. 32, pp. 52, 53.)

The teleology of the plumage of the male Birds-of-Paradise.—The natural inference in the present state of biological science in explanation of the sportive plumage of the male birds-of-paradise would be that it was for the attraction of the females. Little has been known however of the habits of even the comparatively common species. Two English gentlemen, Messrs. Chalmers and Wyatt, while travelling in New Guinea, observed some species, and have recorded a meeting of males and females of one of the species which is of interest in this connection. Their account is here reproduced in their own words:

"One morning we had camped on a spur of the Owen Stanley Range, and being up early, to enjoy the cool atmosphere, I saw, on one of the clumps of trees close by, six birds-of-paradise, four cocks and two hens. The hens were sitting quietly on a branch, and the four cocks, dressed in their very best, their ruffs of green and yellow standing out, giving them a large, handsome appearance about the head and neck, their long, flowing plumes so arranged that every feather seemed carefully combed out, and the long wires stretched well out behind, were dancing in a circle around them. It was an interesting sight; first one, then another, would advance a little nearer to a hen, and she, coquette-like, would retire a little, pretending not to care for any advances. A shot was fired, contrary to my expressed wish; there was a strange commotion, and two of the cocks flew away; the others and the hens remained. Soon the two returned, and again the dance began and continued long. As I had strictly forbidden any more shooting, all fear was gone; and so, after a rest, the males came a little nearer to the dark brown and certainly not pretty hens. Quarreling ensued, and in the end all six birds flew away. Passing through a forest at the back of the Astrolabe, I saw several more engaged as above; our approach startled them, and away they flew. Anxious to taste the flesh, I had one cooked after being skinned; but, although boiled for several hours, it was as tough as leather, and the soup not much to our taste. Fortunately we had other things for dinner, so put the paradise dish aside." (Chalmers and Wyatt's Work and Adventures in New Guinea; *Ibis*, (5), v. 3, pp. 463, 464.)

New Birds-of-Paradise.—The birds-of-paradise are pre-eminent among all birds for the excessive and eccentric development in the males of special feathers, or feathers on special parts of the body, and the great variation observable, in otherwise similar forms, as to the special feathers or parts in which such development is manifested. Almost every genus (eighteen genera were recognized in 1877) has its own peculiar system of hypertrophied or eccentric feather pattern. New Guinea is the headquarters of the family, and of the thirty-four known up to 1877 few were found outside of that great island, and those few only in the neighboring smaller islands and Australia. During the past year six additional species were described from a collection made chiefly in the

Alpine region of southeastern New Guinea, and two of these exhibit phases of plumage entailing generic distinction. They have been described by Messrs. O. Finsch and A. B. Meyer, and beautifully illustrated in the "Zeitschrift für die gesammte Ornithologie." The new species of previously known genera are *Phonygama purpureo-violacea*, *Epimochus Meyeri*, *Paradisea Finschi*, and *Diphyllodes Hunsteini*, while the remaining two (*Astrarchia Stephaniæ* and *Paradisornis Rudolphi*) represent hitherto unknown genera. The *Astrarchia* is related to *Astropia*, but the two middle tail-feathers are very elongated and concave above, while the lateral ones are short. The *Paradisornis* is allied to *Paradisea*, but the two middle tail-feathers are very long, narrow, and spatuliform, and the bill is higher and more compressed; the long flank-plumes are especially remarkable for the blue of different shades which distinguish them. (*Z. g. O.*, v. 2, pp. 369–391, pl. 15–22.)

An insular genus of Birds.—The faunas of the archipelagos are interesting on account of the limited distribution of the resident species and the fact that many of those species are peculiar to special islands or groups of neighboring islands, but represented by kindred species in other parts of the archipelago. Such is the case with a genus of warblers (Certhiola) almost characteristic of the West Indies, although several species are likewise found on the mainland of South and Middle America or in Florida. The species of the genus have been subjected to a revision lately by Mr. Robert Ridgway, and nineteen species are admitted. Of these four species (*Certhiola bahamensis*, *C. mexicana*, *C. luteola*, and *C. chloropyga*) are found on the mainland, two (*C. mexicana* and *C. chloropyga*) being confined to the continent, while of the others one (*C. bahamensis*) is found in Southern Florida as well as the Bahamas, and another (*C. luteola*) occurs in Tobago as well as Trinidad, Venezuela, and Colombia. The other species are exclusively confined to special islands or groups of islands, each of the large or well separated islands, as Cuba, Hayti, Porto Rico, Jamaica, Martinique, and Barbadoes, having its special species. (*Proc. U. S. Nat. Mus.*, v. viii, pp. 25–30.)

Mammals.

The ancestry of Mammals.—Much difference of opinion has prevailed as to the ancestry of the mammals. Formerly it was generally supposed that they were derived from such forms as the Dinosaurians or that they were at least cognate with such reptiles. Later it was urged by Professor Huxley (and the view has been accepted with considerable favor) that the ancestry was to be sought among the amphibians. Against both views, however, there were various objections. Professor Cope has lately been disposed to consider that the nearest of kin were certain reptiles that lived during the Permian epoch. These reptiles have been called the Theromorpha and are characterized in that the quadrate bone is fixed and the ribs are two-headed; the pre-coracoid bone is present and the coracoid bone is of reduced size and is free at the extremity; the vertebral centra are deeply bi-concave, and the pubis is entirely anterior to the ischium, and is united with it without intervening obturator foramen. The order thus distinguished has been mostly studied in remains found in the Permian deposits of Texas, but like forms have been found at the Cape of Good Hope as well as in Permian deposits in Europe. Some of the representatives were of the order long ago exhumed in Cape Colony and were described by Professor Owen under the name Therodontia. The great English naturalist noticed the similarity in the teeth as well as in the bone of the leg, especially of the anterior leg of the reptiles to corresponding parts of mammals, but the full significance of the similarities was not appreciated until subjected to examination by Professor Cope. Professor Cope divides the theromorphous reptiles into two divisions: first, the Anomodontia, where there are several sacral vertebræ, and the vertebræ are not notochordal; and second, the Pelycosauria, where the vertebræ are notochordal, and there are only two or three sacral vertebræ. It is the latter suborder that is most noteworthy. Its species are so far only known from beds of the Permian epoch. They were moreover the only known reptiles of that epoch, for it is not until the following or Triassic period that the orders which characterize Mesozoic time made their appearance.

Professor Cope has given details on the "structure of the columella auris in Clepsydrops leptoupbalus," on the "structure of the quadrate bone in the genus Clepsydrops," and on "the articulation of the ribs in Embolophorus," and on "the posterior foot in Pelycosauria." The consideration of the characteristics revealed by this examination has led Professor Cope to the following conclusions:

(1) "The relations and number of the bones of the posterior foot are those of the Mammalia much more than those of the Reptilia."

(2) "The relations of the astragalus and calcaneum to each other are as in the Monotreme Platypus anatinus," or rather Ornithorhynchus anatinus.

(3) "The articulation of the fibula with both calcaneum and astragalus is as in the Monotreme order of mammals."

(4) "The separate articulation of the anterior part of the astragalus with the tibia is as in the same order."

(5) "The presence of a facet for an articulation of a spur is as in the same order."

(6) "The posterior-exterior direction of the digits is as in the known species of the Monotremata."

Professor Cope concludes from this survey that there are good "reasons for believing that the mammalia are the descendants of the Pelycosauria." (*Proc. Am. Assoc. Adv. Sc.*, v. 33, pp. 471–482.)

The temperature of the body in Monotremes.—The mean temperature of the body of mammals is but little under or over 100° F.:—according to Dr. John Davies' observations on thirty-one different species, 101° 10′ F. The corresponding temperature has been measured by Baron M. Miclucho-Maclay, in two species of Monotremes of Australia, and it appears that it is much lower than in most other mammals, an interesting fact in connection with the relation of the forms to the amphibians and reptiles.

A thermometer inserted in the cloaca of the duck-mole or *Ornithorhynchus paradoxus* and allowed to remain there for five minutes indicated a temperature of 70° 3′ F., the temperature of the air being at the same time 73° 6′ F., and the water of the tub in which it had been placed at 75° 8′ F.

The Spiny ant-eater, or *Tachyglossus aculeatus*, showed a somewhat higher temperature, a thermometer, also introduced into the cloaca, denoting a temperature of 82° 4′ F. Baron Maclay, believing that the large opening of the cloaca had interfered with the correctness of the observations in the case of the first observations, made a small incision, just large enough to introduce the oblong bulb of the thermometer into the cavity of the abdomen, and the thermometer was left in over ten minutes. The scale indicated a temperature of 86° F. (*Proc. Linn. Soc. N. S. Wales*, v. 8, part 4.)

A new Porpoise.—The species of the genus Phocæna, in which are included the typical porpoises (perhaps better known to many as the puffing pigs or bay-porpoises), are in some confusion, it being doubtful whether certain variations observed are of specific or individual value. However, seven species have been quite generally recognized by cetologists. These are all very closely related and agree essentially in the number of vertebræ. But a species has lately been found in the Alaskan waters, and described by Mr. F. W. True as the *Phocœna Dalli*, which differs much from its relatives in the sum of the vertebræ; it has twenty-seven lumbar and forty-nine caudal in place of fourteen lumbar and thirty-two caudal, as has the *Phocœna communis* and (approximately at least) the hitherto known species. In all, the *Phocœna Dalli* has about ninety-seven or ninety-eight vertebræ, while the other species have only from sixty-three to sixty-six. The newly-discovered species exhibits also striking peculiarities in the coloration as well as in the shape of the dorsal fin. The only specimen that has been noticed by naturalists was 6 feet long. (*Proc. U. S. Nat. Mus.*, v. 8, pp. 95, pl. 2–5.)

The Fin-whale Fishery of Norway.—At Vadö, in East Finmarken, fin-whales are found in sufficient numbers to be subjects of a profitable fishery, and various observations have been made on the habits of the animals. In 1885, Dr. Robert Collet, a well-known Norwegian naturalist, made interesting observations upon the structure and habits of Rudolphi's whale (*B. borealis*), which was "captured in considerable numbers during the latter part of July, although the great blue whale (*B. sibbaldii*), generally so numerous," was not then to be seen along the coast. This is attributed to the absence of the Thysanopoda inermis, a small crustacean on which the blue whale feeds. "Rudolphi's whale is called 'seje' or 'cod' whale by the Norwegians, as it appears on the coast at the same time as that fish, but its food is also a crustacean of still smaller species than that, which is the chief nourishment of its gigantic relative." It generally visits the coast of Finmark between May and August, and Guldberg states that its average length is about 40 feet, but it sometimes reaches a length of 50 feet. "Its color is black, and does not exhibit the bluish tint" seen in the B. musculus, as well as B. sibbaldii. "The sides are spotted with white, and the under parts are white with a faint reddish tinge. A new use to which the whales killed at Vadö have been lately put is tinning their flesh, which is said to be wholesome and to find great favor in Catholic countries, where, being fish according to the zoology of the church, it is allowed to be eaten on fast days." (*Nature*, v. 32, p. 374.)

Texan Horses of the Pliocene epoch.—It would seem, from the researches of Professor Cope, that no less than five species of horse-like animals of the genus Equus lived in what is now Texas during the Pliocene period, and some of them appear to have been very abundant. Of these five species, four also lived at same time in the valley of Mexico, while one is "peculiar to the Pacific coast and basin of North America." Of the characteristic species of the eastern United States (*E. fraternus* and *E. major*), only one (the *E. fraternus*) has been found in the Texas deposits. (*Am. Nat.*, v. 19, pp. 1208–1209, pl. 37.)

The Gayal and Gaur.—By the old naturalists, the two largest bovine animals of India known as the gayal and gaur were supposed to be very distinct animals. Of late, however, several have contended that they were merely forms of the same species, one being the wild animal and the other the semi-domesticated form, although others have maintained that the gayal existed as a distinct species in the wild state. It was urged in 1883, by Mr. J. Sarbo, that there is no such thing as a wild gayal. Now, according to Mr. Blanford, "one most important circumstance mentioned by Blyth, on apparently excellent authority, is that the gaur is kept tame in the interior of the Chittagong Hills, and (as a tame animal) is quite distinct from *Bos frontalis*. If this is the case, hybrids are very likely to occur, for the gayal breeds freely with the much less allied Zebu, and such hybrids may account for the occurrence of forms intermediate between the gayal and gaur. An indication that such forms exist is," so far as Mr. Blanford can see, "the only evidence brought forward by Dr. Kuhn in favor of the gayal being a domesticated race of the gaur," the "supposed discovery that the tame gayal or wild gaur inhabit the same country, being," in the words of Mr. Blanford, "a singularly fine example of a *nidus equæ*." (*Nature*, v. 32, p. 243.) In this conflict of testimony and belief, more light is required before implicit reliance in either of the contrasted opinions is safe.

NECROLOGY OF ZOOLOGISTS, 1885.

Baumhauer (Eduard Henry von), secretary of the Holland Society of Sciences at Haarlem; died at Haarlem, January 18, 1885, in the sixty-sixth year of his age.

Bland (Thomas), a well-known student of American land shells, long resident in Brooklyn, N. Y., where he died August 20, 1885. He was born in Nottinghamshire, England, October 4, 1809.

Carpenter (Dr. William Benjamin), a very eminent English physiologist and naturalist, died in London, November 10, 1885, aged seventy-two.

Davidson (Thomas), an English palæontologist, who devoted the greater part of his life to the study of the Brachiopods, died at West Brighton, October 16, 1885, in his sixty-ninth year.

Dunker (Prof.), a German palæontologist and mineralogist, died at Marburg.

Edwards (Henri Milne), one of the most distinguished zoologists of the century; born October 23, 1800, at Bruges, Belgium; died July 29, 1885, at Paris.

Esmark (Lauritz), director of the zoological museum of the University of Christiana, Norway, died in Christiana, December —, 1885.

Guy (W. A.), F. R. S., an English physiologist and physician, died September 10, 1885, in the seventy-sixth year of his age.

Harting (P.), professor of zoology in the University of Utrecht, died at Utrecht, December 7, 1885.

Heule (———), one of the most eminent of European anatomists, died at Göttingen, May 13, 1885.

Hough (Franklin Benjamin), for a time United States commissioner of forestry, and a student of natural history, died June 11, 1885, aged sixty-two.

Jeffreys (John Gwyn), an English conchologist, died at London, January 24, 1885. He was born at Swansea, Wales, January 18, 1809.

Joly (Nicolas), a French naturalist, died at Toulouse, October 17, 1885, in the seventy-fourth year of his age.

Kerr (William C.), of the United States Geological Survey and long State geologist of North Carolina, died at Asheville, N. C., August 9, 1885.

Martin (Philipp Leopold), a writer on zoological subjects, and especially on museology and taxidermy, died March 7, 1885, aged seventy.

Nevill (Geoffrey), an English conchologist, author of a number of papers on Indian shells, &c., died at Davos Platz, February 10, 1885, in his forty-second year.

Parry (Maj. F. T. Sidney), an English entomologist, died February 1, 1885.

Peale (Titian Ramsay), a contemporary of Say and Lesueur, and naturalist of the United States exploring expedition commanded by Wilkes, died at Philadelphia March 13, 1885, in his eighty-sixth year.

Robin (Charles), professor of histology in the faculty of medicine at Paris since 1832, died at Paris, October, 1885, in the sixty-fifth year of his age.

Rye (Edward Caldwell), an English entomologist, died February 7, 1885, aged fifty-two.

Severtsoff (N.), a Russian zoologist, died from cold, resulting from a fall through the ice in the river Don, January 11, 1885.

Siebold (**Carl Theodor Ernst von**), one of the most learned and celebrated of European biologists, died at Munich, April —, 1885; born at Würzburg, February 16, 1804.

Stein (**Friedrich Ritter von**), professor of zoology in the University of Prague, died February —, 1885, aged sixty-seven.

Weyenbergh (**H.**), professor of zoology in the University of Cordoba, Argentine Republic, died at Haarlem (Holland), July 25, 1885.

Wood (**William**), a student of American ornithology, died at East Windsor Hill, Conn., August 9, 1885, aged sixty-three years.

ANTHROPOLOGY.

By Otis T. Mason.

INTRODUCTION.

An exhaustive chronicle of Anthropology for the year 1885 would contain the account of a few general and a vast number of special works of great importance. A cursory view of the titles appended to this brief summary reveals the fact that new portions of the human frame, and new groups of human phenomena, are yearly brought within the area of scientific investigation. Hand in hand with the widening of the domain of inquiry has gone on, also, the invention of more refined apparatus of research, and the increase of ingenious methods for bringing knowledge into new combinations to ascertain and express means and averages. With respect to the last point, it is gratifying to note that more than one anthropologist has realized the fact that any expression of means which does not also preserve the exact status of each component is faulty.

There is one element of true scientific investigation which, under the pressure of circumstances, is being better systematized by anthropologists. It is the classification of the subjects with which they have to deal, according to the laws of evidence. If we may be permitted the use of the term, the knowledges which underlie their scientific speculations and deductions differ most widely, some resting on the testimony of a single individual who has destroyed the last vestige of evidence by which he could make good his word; other reasonings are based upon the preservation of material in such form and abundance, and with such authentication, as to put it within the power of any investigator to report experiments or examine methods. Surely conclusions based upon these two kinds of evidence would differ greatly in their breadth of base. If a report of progress in any science should not omit to call attention to improvements manifested in the methods of the investigator, much more should it mark growing tendencies to conform itself to rigid logic in its inferences.

WORKS OF GENERAL IMPORTANCE.

The Academy of Natural Sciences in Philadelphia organized courses of scientific lectures during the year, and elected Dr. Daniel G. Brinton, professor of ethnology and archæology. The subjects covered were Palæolithic Man; the Races of Men; the White Race; Civilization, its Origin and Elements, its Centers, its Stages, and its Goal; Art in stone, wood, bone, shell, metal, and clay; Textile art and decoration, and Mnemonic design.

The American Association for the Advancement of Science met at Ann Arbor, Mich. The section of anthropology, under the vice-presidency of Mr. William H. Dall, confined its discussions chiefly to those lines easily suggested by the environment, viz., the mound-builders, and the Dakota stock of Indians. The vice-presidential address was a studied discussion of the tribes of Alaska.

Volume VI of the Index-Catalogue of the Surgeon-General's Library appeared in 1885, with titles from Heastie to Inseldt. Works of value to anthropologists will be found catalogued under Heredity, Hermaphrodites, Hippocrates, Histology, Homicide, Humerus, Hypnotism, Idiots, Imagination, India, Indians, Infant, Infanticide, Insane and Insanity (157 closely printed pages), and Insects.

Pilling's Bibliography contains the titles in full, and in important cases, an abstract of everything that has been published upon the languages of North American aborigines. Six years of uninterrupted labor have been bestowed upon this colossal work. The index to the volume furnishes an excellent synonymy of tribal names.

The work of the Bureau of Ethnology of the Smithsonian Institution, included that done in the field by archæologists, ethnologists, and linguists, and the publication of the third annual report. The special papers will be referred to under the names of their contributors. The introduction, by Maj. J. W. Powell, the Director of the Bureau, is far more than a *résumé* of the labors of others. The paper on Omaha Sociology, by Mr. Dorsey, evoked the expression of the Director's opinions upon sociology among savages, a subject to which he has devoted much thought; and Mr. Dall's paper on Labretifery and Masks draws out a chapter on activital similarities, in which certain rules are laid down with reference to the origin of like inventions in different parts of the world.

The Smithsonian Annual Report for 1885 will contain two volumes, one relating to the work of the Institution, the second to the work of the National Museum, where the subject of Anthropology is organized as follows:

1. Arts and Industries. Mr. G. Brown Goode, assisted by Mr. R. T. Earle, on Fisheries; Captain Collins, on Navigation; Mr. William H. Holmes and A. Howard Clarke, on Keramics; Romyn Hitchcock, on Textiles and Foods.
2. Ethnology and Aboriginal Technology. Prof. Otis P. Mason.
3. Archæology. Dr. Charles Rau.

Anthropo-biology, Anatomy, and Anthropometry, are under the charge of the Army Medical Museum.

Art and mediæval armor find their resting place at present in the Corcoran Art Gallery.

In 1885 was organized in Washington the Woman's Anthropological Society, with Mrs. Tilly Stevenson as president, and Miss Sarah Scull as corresponding secretary. The object of this association is twofold—to conduct investigations to which the avenues are especially open to women, and to encourage the sex in the prosecution of scientific work.

The École d'Anthropologie, of Paris, carried through successfully during the year the following programme:

Zoologic Anthropology.—M. Mathias Duval. Anthropogeny and Embryology compared; study of the first phases of development.

General Anthropology.—Dr. Paul Topinard. Analytical study of racial characteristics; difference between races and peoples; evolution of races in time.

Prehistoric Anthropology.—M. de Mortillet. Les Temps photohistoriques.

Ethnology.—M. Dally. 1. Description of human races; their geographical distribution; races supposed to be pure, crosses of certain ethnic groups. 2. Sociology according to Compte & Spencer.

Linguistic Anthropology.—M. Hovelacque. Language in its relations to races and peoples.

Medical Geography.—M. Bordier. Influences of environment and in particular of social environment upon the production, progress, and spread of diseases.

Complementary course.—Zoologic Anthropology. M. Hervé. Parallelisms of anatomy between man and the higher animals. Comparative anatomy of the muscles and the viscera. Comparative and human teratology; monstrosities in general.

Biologic Anthropology.—M. Blanchard. General physiological resemblances between man and the animals.

Composite Photography is taking its place among the instruments of anthropology, in one case the handwriting having been subjected to its methods in order to arrive at the type or mean expression of each letter. In this case the purpose was to detect fraud. Dr. Neubauer has made an excellent study of the race types of the Jews, followed up by Mr. Jacobs with a similar investigation concerning the modern Jews. His composite photographs of Jewish lads will be examined with great interest.

A serious problem in deductive anthropology is a graphic method of illustration, which, while it exhibits means and averages, at the same time does not conceal individualities. Tables of means have long given dissatisfaction. Binomial curves are of great use up to three or four series, after that, colors must be used, the printing of which is expensive. It has been the practice with the author of this summary in showing the distribution of mounds, &c., to take a county or township map, and to put a dot or other plain symbol for each mound, heap, work, &c.

The result, of course, exhibits *in situ* the extent and density of each type. M. Manouvrier has improved on this in a paper read before the Paris Anthropological Society. His plan is to place across the top of the page the whole range of indices, each index number inclosed between two vertical lines. Down the left margin of the page may be written the names, races, &c., under consideration. Each measurement taken is indicated by a dot in the proper square. In the space with the name may occur the whole number of examples, while at the right extremity of the same line may be written the mean. This system is varied by M. Manouvrier by introducing horizontal lines of dots for squares and putting actual fractional parts for dots.

The Société Américaine de France has undertaken the composition of a dictionary of American archæology to be published in its name and under its auspices. A committee has been appointed to divide the work among the members of the society. The secretary of the committee will prepare the list of words for the dictionary. The committee consists of the following-named gentlemen: MM. Auben, Léon de Rosny, Malte Brun, Castaing, Remi, Simeon, and Peuvrier.

ARCHÆOLOGY.

Mr. William H. Holmes had occasion during the year to examine the collections of mound-builders pottery in the Museum of the Davenport Academy. In paste, manipulation, and functions, this ware differs not in the least from that which has been frequently described as coming from the Mississippi Valley. The great merit of Mr. Holmes's work is the analysis and classification of form and the philosophic treatment of the subject of decoration.

An archæological experiment of the greatest value was made by Mr. Holmes. Noticing that very many fragments of ancient American pottery preserved marks of textiles he conceived the notion that a cast in fine sculptor's clay or plaster would restore the fabric. The methods and results of these experiments are given in the third annual report of the Bureau of Ethnology. It is highly important that these experiments should be followed up on pottery from different parts of the world. The same author has published a paper on the evidences of successive populations in the valley of the city of Mexico.

Dr. Abbott's publication in the American Naturalist on archæological frauds opens our eyes to the enormous amount of these practices. Aristotle's rule not to believe an archæologist unless he preserves the evidences of his assertions, will have to be rigorously applied, in order to subdue this pestilential element in a noble science.

The Rev. S. D. Peet has written a series of articles on the symbolism of the ancient Americans, his work being mainly directed to collating the many types used in mythic representations.

The American Journal of Archæology and History of Fine Arts was founded at the Johns Hopkins University under the editorship of Mr. A. S. Frothingham. The numbers which have appeared exhibit the policy of the journal to be of the exalted standard adopted by the other serial publications of the university.

The discussion of the question, who were the mound-builders? has received a fresh impetus from the ground taken by Major Powell and the Bureau of Ethnology that the so-called mound-builders were none others than the immediate ancestors of the Indians inhabiting the United States at the time of its first exploration. Mr. Cyrus Thomas has devoted several papers to the discussion of the subject.

A course of Archæology was endowed during the year in Lisbon under the patronage of Prince Charles, and in charge of M. da Silva. Prizes to the amount of $250 will be divided among the students.

The Precursor of Man.—M. Gabriel de Mortillet is the author of the theory that the flints of Thenay were the workmanship not of man at all but of his precursor, the anthropopithecus. The argument of this distinguished archæologist is somewhat as follows: The study of paleontology acquaints us with the succession of animals. We know that animals have varied from one epoch to another, and that these variations are the more profound as the epochs are removed in time. We know also that the higher the organism the more rapid have been the variations.

The mammals of the upper Tertiary are different from those of today. Man cannot have escaped this law. If evidences of workmanship exist in the Tertiary, they prove the existence not of man but of his precursor. 1. In Otta, Portugal, in the valley of the Tagus, at the base of the Pliocene, have been found worked flints. 2. Puy Courny, near Aurillac (Cantal), same horizon, has furnished silex both wrought and transported. 3. Thenay (Loir-et-Cher) reveals a being intelligent enough to soften flint by fire in order to make it more tractable, although the beds are older than those of Otta or Puy Courny, in fact they belong to the lower Miocene or the upper Eocene. M. Mortillet examines carefully the question of natural cleavage of flint, and decides that those of Thenay afford unmistakable evidences of anthropopithecan workmanship.

In reply to M. Mortillet several archæologists have taken the view that the so-called crackled and retouched flints of Thenay are not the products of human workmanship at all. On the other hand, M. de Quatrefages, admitting for argument sake the existence of wrought flints from the Tertiary, combats de Mortillet's theory of anthropopithecus, alleging that man could have lived in that period. "It may be true," says de Quatrefages, "that during the Tertiary and since mammalian fauna may have been renewed again and again, and that not one species belonging to that time survives, but the discoveries made in the Quaternary gravels of Nerbaddah and Quadavéry lead us to suppose even this assertion exaggerated. The law governing mammalian existence does not apply to man. Independent of his animal nature man possesses an intelligence which enables him to contend successfully with nature, even when he is in the lowest condition of social and intellectual development. If man lived in the Tertiary he was certainly as able to defend himself against the deleterious influences resulting from geological changes as he is to-day, against the extremes of heat and cold." It also occurs to us that the pithecan ancestors of man had progressed further in the faculty of invention than have any modern apes. In other words, if Tertiary apes utilized fire and chipped flints, modern apes should also retain these arts.

In the Proceedings of the United States National Museum will be found a detailed description of the Chaclacayo trephined skull from a cemetery near Lima, Peru, which is the most remarkable case of post-mortem trephining reported. Eight distinct furrows were cut in order to remove the section, which is nearly 2½ inches in diameter.

BIOLOGY.

Professor Cope, in his discussion of the origin of man and the other vertebrates, comes to the following conclusion: "An especial point of interest in the phylogeny of man has been brought to light in our North American beds. There are some things in the structure of man and his nearest relatives, the chimpanzee, orang, &c., that lead us to suspect that they have not descended directly from true monkeys, but that they have come from some extinct tribe of lemurs."

In reply to an editorial in Science (VI, 81) asserting that man is of those forms whose ancestry is unknown, Dr. Theodore Gill says, "I cannot but think that the data at hand are already abundant for an answer, and that we can allocate his systematic relationships as well as those of any other animal. It is difficult for me to understand how any one acquainted with the data could reach a conclusion other than that man is the derivative of a form very much like the chimpanzee and gorilla, and that, could his remote ancestors be seen, they would be placed not only in the same family, but in the same group with the African apes."

The pelvic index is the ratio of the transverse to the conjugate diameter of the pelvis brim expressed by integers. Dolichopellic signifies a pelvis, the conjugate diameter of which is longer than the transverse, or closely approaching it, above 95; platypellic, a pelvis in which the transverse diameter greatly exceeds the conjugate, below 90; mesatipellic, a pelvis in which the transverse diameter is not greatly in excess of the conjugate, between 90 and 95. To the thorough discussion of this characteristic Dr. Hennig devotes a monograph published in Archiv *für Anthropologie.*

Dr. Philippe Rey has made an investigation upon the weight of the cerebral lobes, and some of his conclusions will be of interest. Of the 347 subjects examined, 231 were men, 116 women. While the total weight of the right hemisphere predominates over that of the left, the left frontal is heavier than the right. The right occipital is slightly heavier than the left. The difference of weight for the entire anterior region between men and women amounts to 69.65 grains, which constitutes a large proportion of the general cerebral excess of weight in the male sex.

Dr. Lissauer has added the sagittal suture to the other portions of the human cranium which have been used in obtaining anthropological measures. The sagittal curve or Norma sagittalis is obtained by sawing the skull through the median line and observing the border of the cut within the sagittal suture. Dr. Lissauer, by means of a special craniograph, obtains the profile of the sagittal line on the anteroposterior median plane of the skull. Certain points are fixed on the periphery, and by comparing them among themselves and in relation to a central point located at the intersection of the vomer with the lower face of the sphenoid, he obtains angles by means of which he compares the relative value of the different segments, and also certain of these lines with the *horizontal*, extending from the point named to the external occipital protuberance. A new vocabulary is introduced which will add much to the complexity of craniometry. The ethnic results of the paper may be thus set forth:

Loxodontes	Micrencranes		Bushmen. Typical negroes.
	Mesencranes	Forehead, flat	Australians.
		bulged	Negro children. Kaffirs.
		Occiput, flat	Mongols (part).
		bulged	Eskimos.
		Parietals bulged	Malays. Melanesians (part).
		Front of palatal straight	Americans.
		Nose elevated	Mediterraneans.
	Macrencranes		Negro children. Hottentot woman. Malays. Papuans. Mongols.
Orthiodontes	Loxoprosopes, cerebral sector, small		Americans.
	Orthioprosopes " " large		Mongols. Mediterraneans.

Dr. Herman Welcker, in Halle, has made a study of the capacity of the cranium in connection with the three diameters. He first examines carefully the methods employed for the curvature of the skull by different processes and materials. The tables appended to the investigation exhibit enormous variations in the results, as a few examples will show. The following table gives the people, the author, the number of crania examined, and the average contents in cubic centimeters.

This study of Dr. Welcker's is worthy the attention of all anthropologists:

People.	Author.	Number of crania examined.	Average contents in cubic centimeters.
1. Germans	Welcker	30	1,460
	Morton		1,475
	Weisbach	68	1,524
	Lucae	12	1,532
	Davis	8	1,664
2. Hindus	Welcker	12	1,275
	Morton		1,311
	Flower	22	1,313
	Swaving	11	1,343
	Quatrefages	14	1,400
	Davis	26	1,425
6. French	Schaaffhausen	13	1,430
	Roth	9	1,453
	Hudler	56	1,475
	Welcker	13	1,492
	Davis	22	1,503
	Broca	124	1,558
7. Italians	Welcker	6	1,443
	Flower	76	1,475
	Schaaffhausen	11	1,486
	Weisbach	39	1,507
	Davis	7	1,566
9. Russians	Schmidt	7	1,390
	Schaaffhausen	30	1,395
	Hudler	5	1,403
	Welcker	14	1,416
	Landzert	40	1,471
	Davis	10	1,596
18. Turks	Schaaffhausen	5	1,387
	Weisbach	37	1,462
	Welcker	8	1,467
	Hudler	5	1,474
	Davis	3	1,526
	Broesike	3	1,547
20. Chinese	Morton		1,344
	Zuckerkandl	11	1,402
	Schaaffhausen	31	1,407
	Flower	16	1,424
	Schmidt	13	1,451
	Ecker	4	1,452
	Swaving	26	1,452
	Welcker	14	1,457
	Lucae	6	1,482
	Quatrefages	24	1,511
	Broca	22	1,518
	Broesike	10	1,518
	Davis	17	1,556
28. Dyaks	Schaaffhausen	5	1,359
	Swaving	8	1,372
	Welcker	9	1,404
	Davis	11	1,435
	Schmidt	7	1,472
	Quatrefages	11	1,530
29. Polynesians	Broesike	8	1,339
	Zuckerhandl	13	1,358
	Morton		1,360
	Schaaffhausen	15	1,387
	Ecker	10	1,415
	Welcker	18	1,443

People.	Author.	Number of crania examined.	Average contents in cubic centimeters.
29. Polynesians—Cont'd.	Broca	54	1,460
	Flower	26	1,469
	Davis	100	1,525
	Quatrefages	39	1,549
30. Australians	Ecker	7	1,208
	Lucae	4	1,217
	Morton	....	1,229
	Hudler	7	1,235
	Schaaffhausen	19	1,247
	Welcker	5	1,294
	Flower	32	1,298
	Davis	12	1,319
	Broca	18	1,347
	Zuckerkandl	3	1,377
31. Papuans	Ecker	3	1,215
	Schaaffhausen	8	1,274
	Broesike	3	1,353
	Welcker	20	1,373
	Meyer	54	1,398
	Regalia	48	1,427
	Davis	3	1,495
32. Negroes	Schaaffhausen	27	1,288
	Ecker	53	1,295
	Swaving	14	1,309
	Welcker	19	1,328
	Zuckerkandl	4	1.339
	Lucae	5	1,344
	Hudler	8	1,352
	Schmidt	21	1,356
	Morton	....	1,360
	Flower	26	1,388
	Roth	3	1,405
	Kupffer	3	1,405
	Quatrefages	85	1,410
	Broca	85	1,430
	Davis	12	1,443
35. Eskimo	Schaaffhausen	7	1,391
	Morton	....	1,410
	Welcker	11	1,468
	Quatrefages	13	1,522
	Broca	12	1,539
	Davis	13	1,542
	Flower	17	1,546

The next point which Mr. Welcker considers is the so-called *modulus* (found by adding the three diameters of the skull) and its relation to the cubature, in dolicocephalic, mesocephalic, brachycephalic crania.

Chapter III discusses the cubature of the skull as well as its height and width among different peoples. Six pages are devoted to a table of these three measures upon different races. The table of cubatures, on pages 106, 107, represents the different races arranged in the order of the contents of the skull.

Chapter IV is devoted to the cephalic index. Table IV, page 126, like the one just mentioned on page 106, exhibits in a graphic manner the various races according to the cephalic index. This table is introduced in order to exhibit the author's method of graphic illustration.

Skull capacity by different nations (C. C. M.).

	Germans.	Celts, Romans, and Greeks.	Slaves.	Farther India people.	Semites and Hamites.	
1200						1200
10						10
20						20
30						30
40						40
50						50
60				5 Hindoo Rajputs 1258	4 Abyssinians 1258	60
70				12 Hindoos of Bellari.... 1275 6 Bhils, Gols, Khols 1276		70
80						80
90				18 Better Hindoos........1285		90
1300						1300
10				16 Hindoos (v. Schlgw.), Thakurs, Kabars, Sikhs, &c 1322		10
20					4 Jews from the "Field of Blood" at Jerusalem.1322	20
30				5 Gorkhas...............1326 5 Singalese...............1331 9 Sudras 1335		30
40					13 New Egyptians........1343 23 Old Egyptians.........1347	40
50						50
60				6 Hindoos and Bengalese 1361 14 Ziganis .... 1364 3 "High-caste" Hindoos 1369 5 Hindoo Brâhmans 1370		60
70						70
80						80
90		23 Ancient Romans (II)...1387				90
1400					5 Kaybles 1400	1400

Skull capacity by different nations (C. C, M.)

	Germans.	Celts, Romans, and Greeks.	Slaves.	Farther India people.	Semites and Hamites.	
1400						1400
		20 Ancient Romans (I)....1406	18 Little Russians 1407		14 Guanches..............1401	
10	15 Zuyderseo Islanders...1414	10 Roumanians 1408				10
	17 .... do 1423					
20	20 Swedes 1426					20
	5 Swiss, Dissenters 1427					
30	20 Thuringians 1432					30
	10 Danes and Norwegians.1432	13 Venetians..............1432				
40	3 Icelanders 1440					40
	4 Swiss 1440					
50		13 Irish 1450			20 Jews 1451	50
	60 Region of Halle........1460	10 Neo Greeks.............1458				
60	24 German-Austrians 1462	20 Italians (not Venetians)1460	38 Great Russians 1461			60
	24 Schleswig-Holstein 1467	7 Portuguese 1467				
70	14 Rhine Franks...........1476	11 Spaniards...............1472	18 Poles 1472			70
	16 Hollanders 1478				15 Arabs 1476	
80	15 Suabians................1485		6 Servians 1485			80
	10 North Hollanders 1485		6 Ruthenians 1485			
90			6 Slowaks.................1489			90
	11 Hanoverians 1494	12 Ancient Greeks........1494				
1500		28 French..................1498				1500
	20 Hessians 1503	12 Scotch 1503	36 Czechs 1506			
10						10
	20 Breisgue................1512					
20						20
30	15 English 1531		8 Croats 1525			30
40	20 Ancient Bavarians 1540					40
1550	12 Swiss of different cantons 1543					1550

Skull capacity by different nations (C. C. M.)—Continued.

	Mongols.	Malays.	Papuans and Australians.	Negroes and Koi-Kois.	Americans.	
1200					7 North Americans (artificially deformed)....1176	1200
10						10
20						20
30					10 Caribs..................1232	30
40				10 Bushmen..............1240		40
50						50
60					23 Old Peruvians (deformed)..................1265	60
70		7 Nukuhivans............1267				70
80						80
90				6 Donkas................1294		90
1300				5 Negroes, E. Soudan....1294		1300
10				12 Ashantis..............1313		10
20	13 Thibetans.............1322		20 Australians............1321	38 Negroes, different origins..................1320	5 Brazilians.............1322	20
30				5 Maravi negroes........1322	4 Peruvians (not deformed)..................1335	30
40				20 Kaffirs.................1336 7 Negroes, Lower Guinea 1340		40
50	3 Burmans..............1352	5 Tahitans and Paumotans..............1350 4 Mendanoese............1352				50
60				7 Mozambique negroes..1359	8 Botocudos.............1359	60
70	11 Estens................1371	23 Dyaks................1373	20 Papuans..............1372	10 Hottentots............1369		70
80		18 Bugis..................1379 14 Maoris................1384			6 Eskimos, Labrador.....1378 6 Mexican Indians......1379 4 Aymaras..............1384	80
90	8 Japanese..............1385	7 Sundanese.............1386 4 Nicobarese...........1387 10 Balinese.............1390		5 Negroes, W. and Middle Soudan...........1387		90
1400	12 Lapps................1400					1400

Skull capacity by different nations (C. C. M.)—Continued.

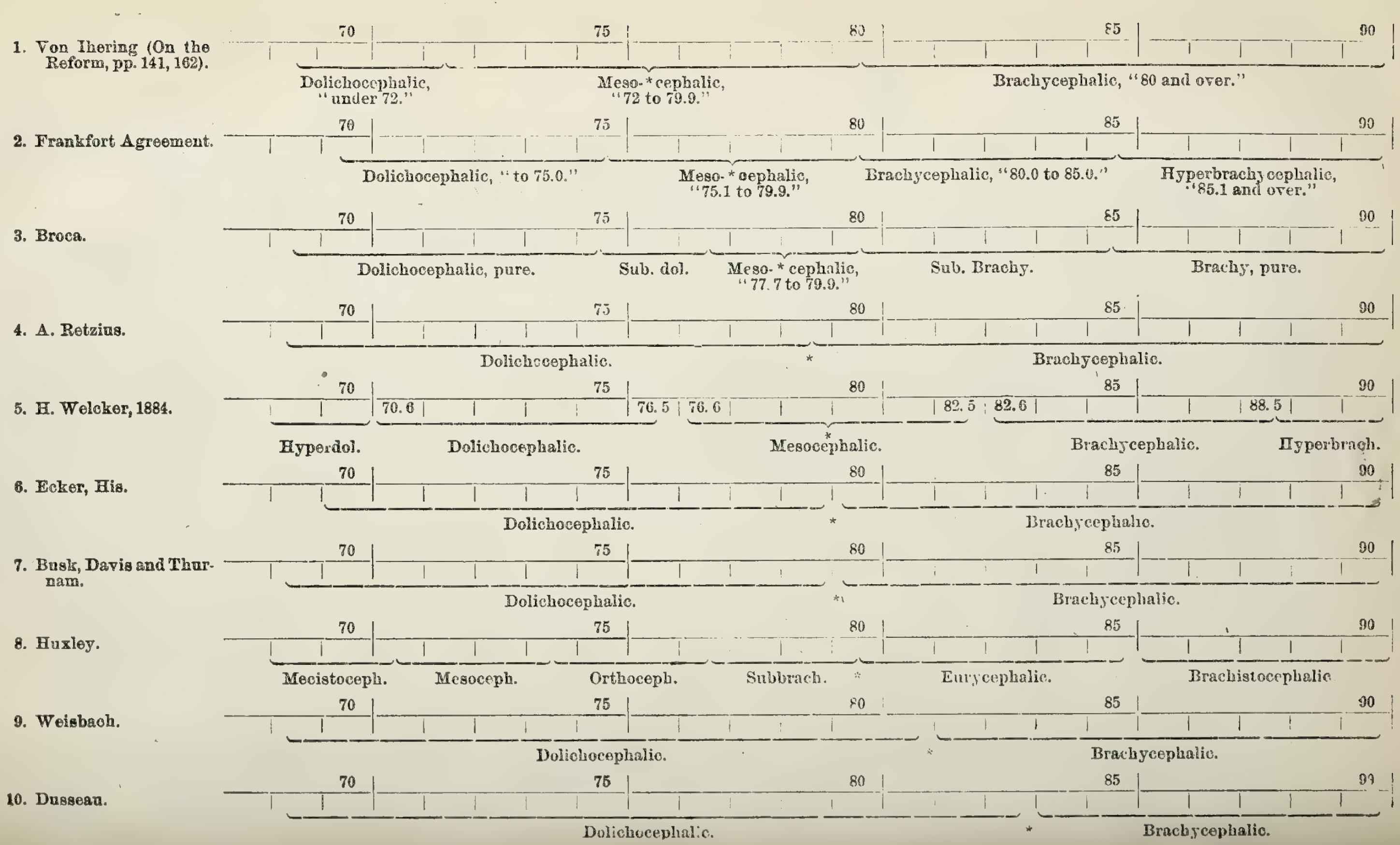
	Mongols.	Malays.	Papuans and Australians.	Negroes and Koi-Kois.	Americans.	
1400						1400
10	5 Tunguese 1410	19 Madurese .... 1419 20 Amboinese 1421			9 Araucanians and Patagonians .... 1402 11 Northwest Americans 1405	10
20		15 Macassars .... 1424 2 Chatham Islanders 1425			6 Puris and Quarapanas 1416	20
30	10 Tartars 1432	7 Different Polynesians .. 1428 7 Ulie, Carolines 1434				30
40	6 Magyars .... 1440 12 Basques 1440	37 Javanese .... 1437 9 Uahuga and Fatuah ... 1441			26 Indians of the United States 1440	40
50	54 Chinese 1444	22 Sumatrans 1455			29 Greenlanders 1452	50
60	8 from the Kurgans of Sarepta .... 1444 23 Turks 1452					60
70	17 Fins .... 1464 22 Kalmucks 1466		2 New Caledonians 1463			70
80	24 Siamese 1471					80
90	8 Burats 1489	14 Hawaiians 1487				90
1500						1500

Width indices of the various nations.—WELCKER.

	L. B.	Mediterranean races.	Mongols.	Malays, Papuans, and Australians.	Negroes and Koi-Kois.	Americans.
Dolichocephalic	70			70.6 Polynesians.	70.9 Maravi negroes.	
	71	71.3 Abyssinians.		71.1 Caroline Islanders of Ulie.	71.1 Koi-Koi	71.7 Eskimo of Labrador.
		71.4 Hindoos of Bellary.			71.1 Guinea negroes. 71.8 Ashantees	
	72			72 New Caledonians.	72.3 Mean of 7 negro groups. 72.3 Kaffirs	72.2 Greenlanders.
				72.7 Papuans of Mysore.		
	73			73.3 Australians.	73.1 Negroes of Middle and West Soudan.	
		73.6 Modern Egyptians.			73.5 Mozambique negroes.	
		73.9 mean of 7 Hindu groups.				
	74					74.3 Puris, Quarapavis (Brazilians). 74.8 mean of the Brazilian Indians.
	75	75.1 Bhils, Gols. Khols. 75.4 Irish	75.3 Thibetans.	75.9 Mean of Polynesians.		
	76	76.2 Ancient Romans. 76.3 Singalese 76.9 Arabs		76.4 Maoris, Nukuhivvi.		
Mesocephalic	77	77.1 Ancient Egyptians and Greeks.	77.1 Estans	77.1 Tahitians		77.0 Botocudos.
		77.2 Swedes, 77.3 Spanish.	77.5 Burmans	77.3 Oahuans and Fatuhiwans.		
		77.7 Kabyles		77.4 Nicobars 77.7 Dyaks		
	78	78.0 Dutch 78.2 Guanches and Ziganis.				78.3 Mexican Indians.
		78.3 Hindu Sudras 78.6 Danes and Norwegians, 78.8 Scotch. 78.9 English				78.9 Indians of the U. S.
	79	79.0 Portuguese	79.1 Chinese	79.0 Balinese		
		79.1 Zuyder Sea Islanders and Icelanders.		79.1 Amboinese		
		79.8 Low German.	79.8 Tartars	79.7 Hawaiians		
	80	80.0 Modern Greeks	80.2 Japanese.			80.1 Araucanians and Patagonians.
		80.8 Gorkhas	80.3 Finns			80.1 Undeformed Peruvians.
	81	81.3 Middle German.	81.9 Magyars	81.3 Mean of Asiatic Malays.		
		81.6 Servians, 81.7 Italians, 81.8 Jews, Little Russians.		81.8 Sumatrans, Macassars.		81.7 NW. Americans. 81.7 Undeformed Caribs.
	82	82.0 Great Russians.				
		82.1 Poles, 82.2 High German and French.		82 Bugis 82.3 Javanese 82.9 Mendanoese		

Width indices of the various nations—Continued.

	L. B.	Mediterranean races.	Mongols.	Malays, Papuans, and Australians.	Negroes and Koi-Kois.	Americans.
Brachycephalic.	83	83.0 Ruthenians 83.3 Roumanians	83.0 Kalmucks, Basques. 83.3 Turks 83.6 Tunguse			
	84	84.1 Slovaks 84.2 Czechs	84.3 Siamese	84.6 Sundanese		
	85	85.1 Croats	85.1 Burjats 85.5 Lapps	85.7 Madurese		
	86					
	87					
	88	88.3 From the Kurgans near Serepta.				
	89 and over					96.7 Ancient Peruvians. 102.0 Deformed North Americans.


1. Von Ihering (On the Reform, pp. 141, 162).
70
75
80
85
90
Dolichocephalic, "under 72."
Meso-*cephalic, "72 to 79.9."
Brachycephalic, "80 and over."
2. Frankfort Agreement.
70
75
80
85
90
Dolichocephalic, "to 75.0."
Meso-*cephalic, "75.1 to 79.9."
Brachycephalic, "80.0 to 85.0."
Hyperbrachycephalic, "85.1 and over."
3. Broca.
70
75
80
85
90
Dolichocephalic, pure.
Sub. dol.
Meso-*cephalic, "77.7 to 79.9."
Sub. Brachy.
Brachy, pure.
4. A. Retzius.
70
75
80
85
90
Dolichocephalic.
*
Brachycephalic.
5. H. Welcker, 1884.
70
75
80
85
90
70.6
76.5
76.6
82.5
82.6
88.5
Hyperdol.
Dolichocephalic.
*
Mesocephalic.
Brachycephalic.
Hyperbrach.
6. Ecker, His.
70
75
80
85
90
Dolichocephalic.
*
Brachycephalic.
7. Busk, Davis and Thurnam.
70
75
80
85
90
Dolichocephalic.
*
Brachycephalic.
8. Huxley.
70
75
80
85
90
Mecistoceph.
Mesoceph.
Orthoceph.
Subbrach.
*
Eurycephalic.
Brachistocephalic
9. Weisbach.
70
75
80
85
90
Dolichocephalic.
*
Brachycephalic.
10. Dusseau.
70
75
80
85
90
Dolichocephalic.
*
Brachycephalic.

Some experiments highly interesting to physiologists are reported in Mr. Francis Galton's vice-presidential address before the British Association. By using a very large number of family records some results regarding stature are made to appear. As with seeds so with men, "offspring did not tend to resemble their parent seed in size, but to be always more mediocre than they—to be smaller than the parents, if the parents were large; to be larger than the parents, if the parents were small." An analysis of the family records gives the numerical value of the regression towards mediocrity as from one to two thirds with unexpected coherence and precision.

The most remarkable production of the year in the field of biological anthropology is Dr. Paul Topinard's Éléments d'Anthropologie Générale, an octavo of 1157 pages, 229 figures, and 5 plates. The volume covers the history of anthropology, the discussion of the general principles, and a minute account of anthropological methods regarding the hair, color of eyes and hair and skin, height, the encephalon, the cranium, and closing with anthropometry upon the living. Only a few of Dr. Topinard's results can be appended. Taking the section of the hair or crinal index as a primary classific concept, he gives the table below:

1. Hair straight, section more or less round, scarce on the face and body: Yellow and red races of Asia and America.
2. Hair nappy or very spiral, section more or less elliptical: Negro races of Africa and Oceanica.
3. Hair more or less curled or wavy, oval in section: Eurhpean races, Australians, Nubians, &c.

The next concept is the nasal index, to which Dr. Topinard attaches great importance. Adding this to the color of the skin we have:

Leptorrhines. (living.) 69 and less.	White races. [Leucoid.]	Hyperleptorrhine.		Anglo-Scandinavian (Kymri).
		Leptorrhine (non aquiline).		Celts.
		Leptorrhine (aquiline).		Semites.
Mesorrhines. (living.) 70 to 81·4.	Yellow races. [Xanthoid.]	Flat noses.	Leptorrhine (cranial).	Eskimo.
			Mesorrhine (cranial).	Yellow races of Asia.
		Salient nose.		Redskins.
Platyrrhines. (living.) 82 and above.	Black races. [Melanoid].	Well formed nose.		African negroes.
		Nose coarse, with enormous alæ.		Melanesians and Australians.

The nasal index on the living is the ratio between the length of the nose from the root to the outer insertion of the septum and the width outside of the alæ.

The subject of color is further discussed in its relation to the eyes and hair and the races grouped as below:

Eyes, color:	Hair, color:
1. Black and blackish, different shades.	1. Absolutely black.
2. Green.	2. Dark brown.
3. Hazel.	3. Clear chestnut.
4. Blue and clear of different shades, including clear gray.	4. (*a*) Blonde, yellowish.
	(*b*) Blonde, reddish.
	(*c*) Blonde, ashy.
	(*d*) Blonde, clear.
	5. Red.

Skin, color:

1. Absolutely black.
2. Brown, shaded with red.
3. Brown, yellowish or olive.
4. Reddish.
5. Yellow or olive.
6. Yellowish white.
7. Brown white.
8. (*a*) Rosy white.
   (*b*) Florid white.
9. Freckled.

By color:		
White (Leucoid).		Blondes, Anglo-Scandinavians or Kymri.
		Chestnut, Celto-Slavs.
		Brunette, Mediterraneans and Semites.
		Reddish (ruddy), one of the two Finnish types.
Yellow.		Yellow proper, races of Asia and Eskimo.
	Red.	Red proper, Redskins and Caribs.
		Yellowish red, Guaranis, Botocudos.
		Olive red, Peruvians.
		Blackish, Charuas (Uruguay), Anct. Cal., So. Dravidas.
Black.		Yellowish, Hottentots.
		Reddish, African Negroes.
		Blacks proper, Australians, Blacks of India, Tasmanians, and Papuans, Negritos, African Negroes.

The cephalic index is the ratio of the greatest skull width divided by the greatest skull length. As to the boundaries of the terms applied to these ratios, most unhappily the doctors disagree. Dr. Topinard's table is as follows:

Dolichocéphaly (74 per cent. and less):

·64 and less. Ultradolichocephaly
·65—·69. Dolichocephaly.
·70—·749. Subdolichocephaly.

Mésaticéphaly(75 to 79.9 per cent.):

·75, ·76. Sub———.
·77 Medium.
·78, ·799. Super.

Brachycéphaly (80 per cent. and over):

·80 to ·84. Sub ———.
·85 to ·89. Super.
·90 and over. Ultra.

The application of the cranial index to the divisions of the human species, previously considered, results as follows:

I. White races.	Dólicho.	Anglo-Scandinavians, Franks, and Germans. Finns of one type, Mediterraneans.
	Mésati.	Semites, Berbers, Egyptians.
	Bráchy.	Celto-Slavs, Ligurians, Lapps.
II. Yellow races.	Dólicho.	Eskimo, ancient Tehuelches, some Americans, Santa Barbara Micronesia here and there; in Asia here and there, Melanesians.
	Mésati.	Polynesians.
	Bráchy.	American type, Alaska, Siberia, Mongols, Mantchoos, Indo-Chinese, Dravidians, Thibetans, Malay.
III. Black races.	Dólicho.	Australians, Veddahs and congeners, typical Melanesians, African Negroes, Bushmen.
	Mésati.	Tasmanians. Mandingos, Haoussas.
	Bráchy.	Negritos of Malaysia and the Andamans.

It will readily be seen that the cranial index in its three branches applies to each of the three divisions of humanity [subspecies?], the significance of which seems to be that the tendency to pass from one to the other belongs to the whole species rather than to any of its three divisions.

In this *résumé* we shall have space to mention but one other characteristic, stature:

Nomenclature of stature.

Statue.	Men.	Women.
Tall	1^{m}, 70 and above	1^{m}; 58 and above.
Ultramedium	1^{m}, 69 to 1^{m}, 65	1^{m}, 57—1^{m}, 53.
Inframedium	1^{m}, 65—1^{m}, 60	1^{m}, 52—1^{m}, 40.
Short	1^{m}, 60—below	1^{m}, 39—below.

Combining this mark with all previously mentioned, Dr. Topinard groups the races studied as follows:

Vivo-nasal index.	Hair.	Cranial index.	Skin color.	Height.	Races.
White subspecies, Leptorrhine.	Wavy (oval section).	Dolichocephalic.	Blonde	Tall	Anglo-Scandinavians.
			Ruddy	do	Finns, type I.
			Brown	Short (relative).	Mediterraneans.
		Mesaticephalic	do	do	Semites, Egyptians.
		Brachycephalic.	do	Short	Lapps, Ligurians.
			Chestnut	Medium	Celto-Slavs.
Yellow subspecies, Mesorrhine.	Coarse, straight round section, long on the head, body glabrous.	Dolichocephalic.	Yellow	Short	Eskimo.
			Reddish	Tall	Tehuelches.
		Mesaticephalic (.76.)	do	do	Polynesians.
		Brachycephalic.	do	do	Redskins.
			Yellow	Short	Yellow race (of Asia).
			Yellowish.	Medium	Guaranis.
			Olivish	Short	Peruvians.
Black subspecies, Platyrrhine.	Bushy (oval section).	Dolichocephalic.	Black	Tall	Australians.
	Woolly (elliptical section).	Dolichocephalic.	Yellowish.	Very short	Bushmen (steatopygians.)
			Black	Tall	Melanesians (eyebrow salient, nose deep at the root).
			Black	do	African negroes.
		Mesaticephalic	do	Medium	Tasmanians.
		Brachycephalic	do	Short	Negritos.

COMPARATIVE PSYCHOLOGY.

Prof. Alexander Bain read a paper at the Aberdeen meeting of the British Association on the scope of anthropology and its relation to the science of mind. The whole burden of the essay was to insist upon amenability to measurements as the password of any set of human phenomena to the section of anthropology. This is as it should be. Mr. Bain further pointed out a great variety of mind actions which were already under the instrument of precision, and others which ought to be and could be. "Psychology has now a very large area of neutral information. It possesses materials gathered by the same methods of rigorous observation and induction that are followed in the other sciences. If these researches are persisted in they will go still further into the heart of psychology as a science; and the true course will be to welcome all the new experiments for determining mental facts with precision, and to treat psychology as an acknowledged member of the section. To this subdivision will then be brought the researches into the brain, and nerves that deal with mental function; the experiments on the senses having reference to our sensations; the whole of the present mathematics of man, bodily and mental; the still more advanced inquiries relating to our intelligence; and the nature of emotion as illustrated by expression."

Instinct.—Mr. Romanes, in an address delivered before the Royal Institution in 1884, and published in their proceedings for 1885, thus defines instinct: "It is the name given to those faculties of mind which are concerned in consciously adaptive action prior to individual experience without necessary knowledge of the relation between the means employed and the ends attained, but similarly performed under similar and frequently recurring circumstances by all individuals of the same species." The origin of instinct, according to the same author, is twofold: it is produced by lapsing intelligence or by natural selection. The former is thus explained: "Just as in the lifetime of an individual, adjustive actions, which were originally intelligent, may by frequent repetition become automatic, so in the lifetime of the species, actions originally intelligent may by frequent repetition and heredity so write their effects on the nervous system that the latter is prepared, even before individual experience, to perform adjustive actions mechanically, which in previous generations were performed intelligently." For the following reasons many instincts are referred to natural selection solely: 1. Considering the great importance of instincts to species they must be in large part subject to natural selection. 2. Many instinctive actions are performed by animals too low in the scale to admit of our supposing that the adjustments which are now intuitive can ever have been intelligent. 3. Among higher animals intuitive actions are performed at an age before intelligence, or the power of learning by individual experience, has begun to assert itself. 4. Many instincts, like incubation, are of a kind which could never have arisen by intelligent observations." Finally, these two causes have coöperated in the formation of instincts.

The distance between intellection and volition on the one hand and the organic processes associated with them seem to be narrowing year by year. Dr. Horsely, in a lecture before the Royal Institution of Great Britain on the motor centers of the brain and the mechanism of the will, omitting the discussion of the existence of the freedom of the will and the sources of our consciousness of voluntary power, arrives at the following conclusions:

As a rule, both cerebral hemispheres are engaged at once in receiving and considering one idea. Under no circumstances can two ideas either be considered or acted upon attentively at the same moment. Therefore the brain is a single instrument. Our idea of our being single individuals is due entirely to this single action of the brain.

The lecturer also pointed out the specific portions of the brain to which physiologists have been able to relegate certain activities.

Prof. Balfour Stewart delivered the annual address before the Society of Psychical Research, in London, August 24, on the occasion of the third anniversary. The exact position of the society is best indicated by the language of Professor Stewart: "To my mind the evidence already adduced is such as to render highly probable the occasional presence amongst us of something which we may call thought-transference, or, more generally, telepathy; but it is surely our duty as a society to accumulate evidence until the existence of such a power cannot be controverted. We have not been remiss in this respect, and it will be found from the pages of our proceedings that the main strength of our society has been given to prove the existence of telepathy, in the belief that such a fact, well established, will not only possess an independent value of its own, but will serve as an admirable basis for further operations."

In a paper on comparative physiology and psychology, published in the American Naturalist, Dr. Clevenger takes the ground that the science of psychology is based upon comparative microscopic anatomy and a physiology into which molecular physics shall enter more in the future. Not only are the laws which bind the social organism similar to and derived from those which govern the units of which it is composed, but the protoplasmic units are governed by the same processes down to chemical affinities.

Mr. Charles Morris contributes to the same journal a series of articles upon mind and matter, in which the limits of the boundaries of consciousness and unconsciousness are discussed.

ETHNOLOGY.

The classification of mankind by blood is ethnology. Professor Flower's presidential address before the Anthropological Institute on January 27 was devoted to this subject. The majority of anthropologists at the close of 1885 leaned towards the theory of the unity of our species. Humanity, according to this view, is included in a single genus (Homo), which contains but one species (Sapiens). Here the consensus ends, but there still remains a tolerably fixed belief that this species contains three subspecies, main varieties or something of that kind. "After a perfectly independent study of the subject," says Professor Flower, "extending over many years, I cannot resist the conclusion, so often arrived at by various anthropologists, and so often abandoned for some more complex system, that the primitive man, whatever he may have been, has in the course of ages divaricated into three extreme types, represented by the Caucasian of Europe, the Mongolian of Asia, and the Ethiopian of Africa, and that all existing individuals of the species can be arranged around these types or somewhere or other between them."

The Ethiopian or Negroid race, may be divided as follows:

A. Africans or typical Negroes.
B. Hottentots and Bushmen.
C. Oceanic negroes or Melanesians.
D. Negritos.

The Mongolian type:

A. Eskimo.
B. Typical Mongolian races of Asia.
C. The Malay.
D. Brown Polynesians.
E. American Indians.

The Caucasian or white division includes:

A. Xanthochroi.
B. Melanochroi.

The Dravidians of India, The Veddahs of Ceylon, and probably the Ainos of Japan and the Maoutze of China belong to this race, which may have contributed something to the mixed character of some tribes of Indo-China and the Polynesian Islands, and given at least the characters of the hair to the otherwise Negroid inhabitants of Australia.

Modern Jews are thus tabulated by Mr. Joseph Jacobs:

	Country.	Number.	Per cent.
A. Jews by religion and birth:			
Ashkenazim	Teutonia, Slavonia	6,500,000	92·8
Sephardum	Romance, Levant, Africa.	425,000	6·1
Samaritans	Nablus	150	
B. Jews by religion, not birth		(75,000)	1·1
Falashas	Abyssinia	50,000	
Karaites	Crimea	6,000	
Daggatoum	Sahara	10,000	
Beni Israel	Bombay	6,500	
Cochin	Cochin	1,600	
C. Jews by birth, not religion		(12,000)	0·2
Chuetar or Anussim	Balearic	6,000	
Maimines	Salonichi	4,000	
G'did al Islam	Khorassan	2,000	

The recent troubles in Bulgaria have evoked a number of volumes treating upon the ethnology of the peoples more or less intimately engaged in the controversy. The works of Lewis Leger, Dr. Kanitz, and Leon Prunel de Rosny may be consulted with profit.

Professor Packard brings together in two articles, published in the American Naturalist, a great deal of interesting information respecting the former southward range of the Eskimo in Labrador. Dr. Franz Boas has in several communications made us well acquainted with his residence among the Eskimos of Baffinland. Mr. Lucien Turner will soon publish an exhaustive monograph upon the Eskimo and Indian populations of Ungava, a region about which little has hitherto been known. Add to these Schwatka's travels, Lieutenant Ray's report on Point Barrow, Lieutenant Stoney's brief report on the Kowak, Murdoch's papers on arts at Point Barrow, Dr. Dall's address on the tribes of Alaska, and we shall have for this year a tolerably comprehensive review of the Eskimo area.

The following is Dr. Dall's outline of the tribes as at present recognized:

Orarians.

INNUIT STOCK.

	Estimated population.
Northwestern Innuit:	
Kopăg-mūt, 1877	———
Kāng-mālig′mūt, 1877	9,100?
Nūwŭk-mūt, 1877	
Nūwātŏg-mūt, 1877	
Kū-ăg′mūt, 1877	
Asiatic Innuit:	
Yuit	———
Island Innuit:	
Imāh-kli-mūt	———
Ing-ŭh-kli-mūt	40?
Shi-wo-kŭg-mūt	150?
Western Innuit:	
Kāviăg′-mūt, 1877	14,500?
Măh′-le-mūt, 1877	
Un-ālig′-mūt, 1877	
Skŏg′-mūt, 1877	
Mag′emūt	
Kai-ā-lig-mūt	
Kŭskwŏg′-mūt	
Nūshāgag′-mūt, 1877	
Oglemūt	
Kăniăg′-mūt	
Chū-gach′igmūt	
Aleutians:	
Unŭngŭn, 1877	2,200?

Indians.

TINNEH OR ATHABASCAN STOCK.

Western Tinneh:	
Kai′-yūh-kho-tā′nā, 1877	2,000?
Ko-yū′-kŭkh-o-tā′-nā, 1877	
Un′-ā-kho-tā′-na, 1877	

Kutchin tribes:	
Ten'-an-kŭt-chin', 1877	700?
Tennŭth'-kŭt-chin', 1877	Extinct.
Tăt-sah'-kŭt-chin', 1877	Extinct.
Kŭt-chā-kŭt-chin', 1877	——
Nahsit'-kŭt-chin, 1877	——
Vŭntā'-kŭt-chin', 1877	——
Hai-ăn-kut-chin (?), 1877	——
Eastern Tinneh:	
K'nai'-ā-kho-tana	614
Ah-tenā', 1877	250
Nehaunees:	
Abbā-to-tenāh, 1877	——
Acheto-tinneh, 1877	
Khŭn-ŭm-āh'	——
Carriers:	
"Takŭlli"	——
T'silkotinneh	
Tlinket or Kalashian stock:	
Chilkaht-kwan	1,314
Yăk-ū-tăt', 1877	500?
Sit-ka-kwan, 1877	4,949
Stakhin-kwan, 1877	
Skŭt-kwan (?) Dawson, 1844	
Haida stock:	
Haida	788
Tsimp-si-an' stock:	
Tsimpi-si-an'	——

Ethnography of Guatemala.—Dr. Otto Stoll, a resident physician in Guatemala, has undertaken to supplement the work of Brasseur and of Berendt on the comparative linguistics of the Central American States. There are eighteen languages now spoken in Guatemala, fourteen of them belonging to the Maya Qu'iché, viz, Maya, Mopan, Chol, Qu'ekchi, Pakonchi, Uspanteca, Ixil. Dr. Stoll divides the Maya in four groups:

A. Tzental.
B. Pokonchi.
C. Qu'iché.
D. Mame.

A. Tzental group.

1. Chontals of Tabasco.
   Synonymy: Do not confound them with the "Chontales" of Nicaragua, who are entirely different.
2. Tzentalis (Ocosingo).
   Synonymy: Celdal (Cespeda).

3. Tzotziles (San Christobal de Chiapas).
   Synonymy: Cinacanteca (Cespeda); Zotzlem (Brasseur) or Zotzil; Quelenes (Spanish historians).
4. Chañabal (Comitan near north of Gautemala).
5. Choles (across Guatemala from Salinas r. to Montagua r.; see p. 90).
   Synonymy: Putum (Berendt); Cholti (Moran); Colchi (Palacio); Ecolchi (Alonzo de Escobar).
6. Mopanes (north of Chols in Gautemala).

B. Poconchi group.

1. Qu'ekchis (east, west, and north of Coban).
   Synonymy: Caechi (Palacio); Caichi (Juarros); Aquacateca, Mame, Qu'iché, Cakchiquel, Tzu'tuzil, Pokomam, Chorti. The Sinca, Pupulca, Pipil, and Carib represent other stocks.
   Dr. Stoll takes up his work in a very systematic manner, stock by stock, giving in each the tribes examined, together with the literature, synonymy, chirography, history, and vocabulary. Thus:
(*a.*) Aztec stock. The Pipils (Escuintla and Cuajiniquailapa).
   Synonymy: Pipil (authors); Mejicano and Nahuatl (Juarros); Nahuatl of the Balsam coast and Izalco (Squier); Mexicanic, or language of the Tlaskaltekas (Scherzer).
(*b*). Mije stock. The Pupulucas (Cognaco extreme southeast).
   Synonymy: Pupuluca (Juarros); Populuca (Palacio); Popoluca (Berendt Mss.). Papaluka (Brasseur) is the name of a Cakchichiquel village, and Scherzer's Pupuluka Katschike is pure Cakchiquel.
(*c.*) Carib stock. The Caribs (Gulf of Honduras).
(*d.*) The Maya-Qu'iché stock; 250 words in 16 languages given. Egkchi (Habel); Cakchi (Charencey); Vater confounds Cacchi with Qu'iché.
2. Pokonchis (around Tactic).
   Synonymy: Spelled Poconchi, Pocomchi, and Pakomchi. The Poconchi of Gage and Scherzer is Pokomam.
3. Pokomams (Guatemala to Jalapa and eastward).
   Synonomy: Poconchi (Gage and Scherzer); Pakome (Charenay)).
4. Chortis (Zacapa and Chequemula and eastward).
   Synomymy: Lenguaapay (Palacio); Chol (Jimenez, by Brasseur).

C. Quiché group.

1. Qu'ichés (Cunen and Rabinal, southwest to Pacific).
   Synonymy: Lengua Utatlica (authors); also Kiché.
2. Uspantaks (S. Miguel Uspantan).
3. Cakchiquels (Tecpan to Sta. Lucia and to Pacific).
   Synonomy: Lengua Achi (Fuentes, Palacio); Cuauhtemalteco? (Palacio); Kacchikil (Vater); Chacciquel (Th. Gage); Pupuluka Katschikel (Scherzer); also Cakchiquelchi.

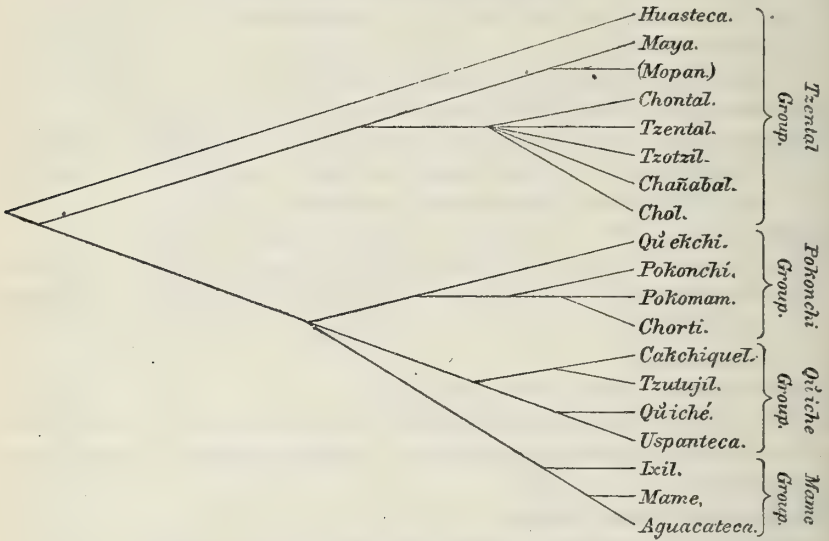
4. Tz'utujiles (around Aitlan).
   Synonymy: Sotojil (Fuentes); also Zutuhil, Tzutohil.

D. Mame group.

1. Ixiles (Cotzal and vicinity).
2. Mames (all Southwestern Guatemala).
   Synonomy: Zakloh-pakap (Reynoso); Mem. (authors).
3. Aguacatecas (Huehuetenango. The Sinca language (Southeast Guatemala).
   Synonomy: Sinca (Juarros); Xinca (Berendt Mss.); Xorti (Gavarrette's chart).

The Alagüilac language (S. Cristobal) little known.

Scheme of the Maya languages.



Dr. John Beddoe has published the result of a study extending over thirty years, prosecuted for the purpose of ascertaining the components in the present population of the British Isles. The color of the hair and eyes is the chief reliance in the author's observations for the analysis of racial distribution in the present population of Britain.

GLOSSOLOGY.

The lecture before the "Conference Transformiste" this year was delivered by M. Abel Hovelacque on the evolution of language. According to the lecture both scientific analysis and the speech of infants prove that language primordially springs from monosyllabic elements. At first the cries and ejaculations of children are intentional, and later they in common with savages express their ideas by emotional tones.

From these rude beginnings language pursues a law of evolution which we may study quite apart from the people who use it, in the same manner and through the same methods as the zoologist studies comparative anatomy. M. Hovelacque relegates language to the class of physiological science, and studies it in its formation, growth, maturity and decay. Monosyllabism is the youth of language, agglutination characterizes its adolescence, flexion its manhood and decrepitude.

An ingenious example of linguistic criticism is that to which Dr. Brinton has subjected the Taensa grammar and dictionary of M. J. Parisot. After scrutinizing the structure of the grammar and examining the errors in climatic and other allusions in the text, Dr. Brinton comes to the conclusion that the whole thing is a forgery. After correspondence with Lucien Adam and F. Müller it seems more probable that the young author had really gotten hold of an ancient manuscript, but that he had so doctored it that he is ashamed to reveal the original. Meanwhile these savants have decided upon a most praiseworthy course, viz, to say nothing about the Taensa grammar until the author produces the original manuscript.

Dr. Daniel G. Brinton appealed to American students to devote themselves to our aboriginal languages, quoting in conclusion the words of Professor Whitney: "The study of American languages is the most fruitful and the most important branch of American archæology."

Philologists are frequently at a loss to see how collectors of vocabularies can have listened so differently to the pronunciation of words of savages. Much of the difference in their vocabularies is doubtless due to a want of uniformity in alphabet and to the nationality of the transcriber. More subtle than either of these causes is that pointed out by Mr. Hale, namely, the existence of elementary sounds of an intermediate character which seem to float between two, and sometimes even three or four, divers articulations.

The linguistic stocks of all the tribes of North America are gradually being worked out by the Bureau of Ethnology. The strip of west coast from Alaska to Mexico, crowded with different languages, is the last to yield to classification. Mr. Dorsey has succeeded in unraveling the little bands on the Siletz Agency with the following result:

Athapascan or Tinné family.—South River; Chetcoe dialect of the Tutu; Joshua and cognate dialects of the Lower Rogue River Indians; Naltunnetunns; Mekwunutunns; Yukwitee or Euchre dialect; Kwatami or Sixes; Upper Coquille; Applegate Creek; Galice Creek; Chasta Costa (Shista Khwu-sta).

Siuslaw.—Siũslaw; Umpqua; Alsea; Yaquina.

Mulluk.—Lower Coquille.

Takelma.—Upper Rogue River.

Sasti.—Shasta.

Klikitat.

COMPARATIVE TECHNOLOGY.

In several quarters a fresh impulse has been given to the intimate study of modern savage technique.

The fact that we have no other clue to the industrial history of the past or to the explanation of the discoveries of the archæologist ought to have directed attention sooner to the necessity of describing savage processes down to the minutial.

Dr. Washington Mathews, in his paper on Navajo weaving, has produced a paper of this class worthy of imitation. Its highest commendation is that any modern weaver could from the description reconstruct the apparatus and produce a Navajo blanket or belt.

Col. F. A. Seeley, of the United States Patent Office, has published a second paper on the genesis of inventions from the standpoint of the patent examiner. A convenient term, *eurematics*, is used to define the study of inventions as to their order and their laws.

Prof. Cyrus Thomas publishes in the third report of the Bureau of Ethnology an elaborate examination of the "Tableau des Bacabs," Codex Cortesianus, and plate 44, Fejervary Codex, to show the intimate relation between the Maya and the Mexican symbols and calendars in their method of representation.

Dr. Brinton's paper on the lineal measures of the semi-civilized nations of Mexico and Central America reaches the following conclusions:

1. In the Maya system of lineal measures, foot, hand, and body measures were nearly equally prominent, but the foot-unit was the customary standard.

2. In the Cakchiquel system hand and body measures were almost exclusively used, and of these those of the hand prevailed.

3. In the Aztec system body measurements were unimportant, hand and arm measures held a secondary position, while the foot measure was adopted as the official and obligatory standard both in commerce and architecture.

4. The Aztec terms for their lineal standard being apparently of Maya origin suggests that their standard was derived from that nation.

5. Neither of the three nations was acquainted with a system of estimation by weight, nor with the use of the plumb-line, nor with an accurate measure of long distances.

SOCIOLOGY.

As a means of realizing a vast amount of material for sociological purposes, the only safe method in such investigations, Dr. Francis Galton has made use of family records, printed questions put in the hands of great numbers of people to be filled up. The results of this inquiry are partially summed up in the vice-presidential address before the section of anthropology in the British Association with the title "Types and their Inheritance." Especial attention is given to stature, for reasons stated in the address. It appears that the offspring does not tend to resemble the parents, but to be always more mediocre than they; to be smaller if the parents were large, to be larger than the parents if the latter were small.

"There can be no doubt," says Mr. Galton, "that heredity proceeds to a considerable extent, perhaps principally, in a piecemeal or piebald fashion, causing the person of the child to be to that extent a mosaic of independent ancestral heritages, one part coming with more or less variation from this progenitor and another from that. To express this aspect of inheritance where particle proceeds from particle, we may conveniently describe it as particulate."

"Whenever a feature in a child was not personally possessed by either parent, but transmitted through one of them from a more distant progenitor, the element whence that feature was developed must have existed in a particulate, though a personal and latent form in the body of the parent. The total heritage of that parent will have included a greater variety of material than was utilized in the formation of his own personal structure." The lecture closes with the application of the argument to the formation of colonies or composite individuals.

Mr. Dall, from his long Alaskan experience, made familiar with masks and labrets, has extended his study into other regions, and produced a work on the geographical distribution of these objects which is of great ethnical value. His speculations lead him to the conclusion that intimate relationship once existed between Oceanica and the western continent.

The Rev. J. Owen Dorsey was for many years among the Dakotan tribes, and became so conversant with their language and habits that he has been invited by the director of the Bureau of Ethnology to prepare an elaborate account of that stock. His monograph upon Omaha Sociology is the first of a series, which will terminate with grammars and vocabularies. Mr. Dorsey is by far the best equipped man in the world to treat this subject. The Omaha belong to the Dhegiha group of the Siouan family, the other member of the family being the Kwapa. In connection with this paper should be read Major Powell's report upon it in the introduction to his third annual report.

Mr. Ward read before the Anthropological Society of Washington a paper of great sociological importance, in which are contrasted moral and material progress. By the former, the author means the actual removal of social evils; by the latter, the discovery of principles and the invention of appliances calculated to remove them. The aim of the paper was to call attention to the fact that while material progress goes on by steady accretions, in which every step is permanent gain, moral progress takes place by a rhythmic action of which only the algebraic sum of its many fluxes and refluxes can be counted. Every age has possessed all the arts of the age that preceded it, and has added something to them, but the welfare of man does not advance by any such method. Mr. Ward sees the reason for this in the fact that knowledge, ingenuity, skill, and industry, well-nigh omnipotent in the accomplishment of anything toward which they can be once fairly directed, have not been applied to moral end and directed to the attainment of social well-being.

MYTHOLOGY AND FOLK-LORE.

A very important addition to the philosophy of animism is that of Mr. J. G. Frazer in his connection of burial customs with the primitive theory of the soul. The whole range of literature has been consulted, and the scrupulous habit of Mr. Frazer in the enumeration of authorities will be of the greatest advantage to those who wish to follow up the subject. The feature most thoroughly examined is the identity of ghosts and the belief in a second or spirit self.

Major Powell, in reviewing Mr. Dall's paper on masks, draws attention to the fact that in paraphernalia, as in folk-lore, the practical passes imperceptibly into the mythical. "Savage mythology deals largely with animal life, and savage drama is intimately associated with savage mythology." Among many North American tribes the old men and women who transmit mythic lore are listened to with great interest, and as the stories of the ancient god-beasts are told, resort is had to dramatic personification to give zest and vigor to the mythic tales.

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PAPERS RELATING TO ANTHROPOLOGY.

OBSERVATIONS ON STONE-CHIPPING.*

By GEORGE ERCOL SELLERS, *of Bowlesville, Ill.*

When a boy, living among mechanics, artists, and artisans, preparing for the profession of civil and mechanical engineer, it was natural that I should be attracted to the studio with its adjoining workshop and taxidermic room of my mother's father, Charles Wilson Peale, and his sons. There was always something new to be learned there. He was a native of the province of Maryland, the son of one of the earliest Episcopal ministers who came from England and settled in that colony. He always took great interest in the history and incidents connected with the early settlement of Maryland and Virginia. He had a shelf in his library devoted to books and pamphlets relating thereto, many of which seemed to have been sent from Europe to him, for they bore inscriptions of "presented by," or "received from," my friend, Sir J. Banks or from Count Rumford, and others. Among them was a volume of autograph letters from his friend Thomas Jefferson on the same subject. This shelf was particularly attractive to me, for it always led to reminiscences of the most interesting character from my grandfather. On one occasion I came across on this library shelf a thin bound volume of letters of John Smith from the Virginia colony. It was a London publication, and (if my recollection is not at fault) comprised several pamphlets bound together. A passage in one of these letters, in describing an Indian he had met with, referred to the making of stone implements. I have not seen the publication since, and cannot after a lapse of more than sixty years quote from it, but will give the substance as impressed on my mind. He said in substance that the Indian carried with him a pouch filled with flakes of precious stones, and within his mantle, in a pocket made for the purpose, a small instrument made of bone or horn, that he *valued above all price* and would not part with, and with it he deftly shaped arrow-points and spear-heads from or out of the stone flakes. On calling my grandfather's attention to this, he said that although there was much truth in what at the time was written from the colonies, some things were highly colored and had to be sifted out or taken with caution, and he supposed the cutting of hard stone with bone or horn was one of these, and might be set down as one of Smith's yarns. I asked myself the question, What object could he have in inventing and telling it? There must be some foundation. At all events, it made an indelible impression on my mind.

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* In the summer of 1885 Mr. Sellers visited Washington and called upon Dr. Rau, to whom he gave an account of his experiences in stone-chipping, but dwelling chiefly on what he had heard from Mr. Catlin concerning this subject. Dr. Rau, perceiving the importance of Mr. Sellers's remarks, induced him to prepare the present article. It will be seen that the Indians of this country resorted in stone-chipping to methods similar to those employed by the Mexicans, as related by Torquemada and Motolinia.

Most of the arrow-points found within my reach in Philadelphia, Delaware, and Chester Counties, Pennsylvania, were chipped from massive quartz, from the opaque white to semi-transparent and occasionally transparent. Once, in company with my early preceptors, Jacob Pearce and Isaiah Lukens, both well-known scientists, on a mineralogical excursion, we came to a place where (judging from the quantities of flakes and chips) arrow-points had been made. After most diligent search only one perfect point was found, which is still in my possession, marked with ink "1818." There were many broken ones, showing the difficulty in working the material. Mr. Lukens collected a quantity of the best flakes to experiment with, and by the strokes of a light hammer roughed out one or two very rude imitations. No effort was made by pressure, which I cannot now understand, for at that time I was in the habit of breaking off points and trimming mineral specimens (likely to be injured by the jarring of a hammer stroke) by pressure with the hickory handle of my mineral hammer.

Maj. S. H. Long, afterwards colonel, who in the latter part of his life succeeded Col. John J. Abert as head of the Topographical Department of the United States Army, whenever in Philadelphia, was a frequent visitor at my father's house; and, when preparing for his expedition to the Rocky Mountains, in which my mother's youngest brother, Titian R. Peale, went as assistant naturalist, I saw him almost daily. The subject of flaking and forming arrow and spear-heads was one of frequent discussion. My grandfather, C. W. Peale, was at that time owner of the Philadelphia Museum, which had for that period a large collection of Indian curiosities, among them, many collected by Lewis and Clark on their northwestern expedition,—and to me the most interesting, was a box of stone implements in various stages of manufacture, evidently collected with the view of illustrating the process. They were never put on exhibition other than in the original package, the lid of the box only having been removed. Major Long's attention was called to these, and he expressed his belief that on his expedition he would learn the entire process, and on his return be able to explain everything in the Lewis and Clark collection.

The expedition returned, and, as far as I know, without any positive information as to the process of making the flakes. Mr. Peale said he had seen squaws chipping flakes into small arrow-points, holding the flake in their left hand, grasped between a piece of bent leather, and chipping off small flakes by pressure, using a small pointed bone in the right hand for that purpose. From this it was evident that John Smith's story was no myth. In my life-long intimacy with Colonel Long the subject of the flaking operation has frequently been one of conversation, on my regretting that more attention had not been paid to it on either of his expeditions. Knowing his pre-eminence as a civil engineer and his high attainments as a mechanic, I thought more reliable information would have been obtained by him and his party, composed as it was of such prominent men of science. He said that flakes prepared for points and other implements seemed to be an object of trade or commerce among the Indian tribes that he came in contact with; that there were but few places where chert or quartzite was found of sufficient hardness and close and even grain to flake well, and at those places there were men very expert at flaking. He had understood that it was mostly done by pressure, and rarely by blows, but he had never witnessed the operation. He expressed his belief that it was an art fast being lost, for he had found among tribes who had never seen a white man since the advent of Lewis and Clark, wrought-iron arrow-points made in England by the Birmingham nailers, sent out as articles of trade by the fur companies, and that they were preferred to the stone points.

My early acquaintance with Catlin, the artist, was in the shop of Catlin, musical instrument and model maker, of Philadelphia. There I knew him as a very expert and superior workman in wood and ivory. As a portrait painter he was not at that time successful. He painted strong likenesses, but they lacked life-like coloring. A delegation of Indians on their way to Washington gave him an opportunity to paint the likeness of one of the chiefs. This was exhibited in the Pennsylvania Academy of Fine Arts, and from its novelty attracted much attention; in fact, it was so far a success as to bring him into notice. About this time I met him very frequently; his conversation always drifted on to the great value and importance of preserving correct likenesses of the Indians, whom he believed to be fast passing away. We all know how well he lived up to this idea, devoting his life to the work of producing the collection of Indian portraits now in the National Museum.

On Mr. Catlin's return from his long sojourn among the Indians, believing that, as an observing practical mechanic, nothing in the way of art among them would escape him, I took the first opportunity to see him. On my inquiry as to the mode in practice of splitting the stone into flakes for arrow and spear points, his reply was by a question characteristic of the man. He asked if I had forgotten Dr. Jones's axiom, "The least possible *momentum* is greater than the greatest possible *pressure*." This was in allusion to a lecture on mechanics we had together heard delivered by Dr. Thomas P. Jones (afterwards Commissioner of Patents). He then added, "That is well understood by the flake makers among the Indians, but it will soon be among the lost arts, just as the nests of Birmingham brass battered-ware kettles, the Yankee tin-ware, and glass whisky bottles have already almost totally destroyed their crude art of pottery making. The rifle is taking the place of the bow and arrow. For boys' practice and for small game the iron points got from the fur traders are preferred to stone. A common jack-knife is worth to them more than all the flint knives and saws ever made."

After expressing himself in this manner he went on to explain what he had seen. He considered making flakes much more of an art than the shaping them into arrow or spear points, for a thorough knowledge of the nature of the stone to be flaked was essential, as a slight difference in its quality necessitated a totally different mode of treatment. The principal source of supply for what he termed home-made flakes was the coarse gravel bars of the rivers, where large pebbles are found; those most easily worked into flakes for small arrow-points were chalcedony, jasper, and agate. Most of the tribes had men who were expert at flaking, and who could decide at sight the best mode of working. Some of these pebbles would split into tolerably good flakes by quick and sharp blows striking on the same point; others would break by a cross fracture into two or more pieces; these were preferred, as good flakes could be split from their clean fractured surface by what Mr. Catlin called *impulsive pressure*, the tool used being a shaft or stick of between 2 and 3 inches diameter, varying in length from 30 inches to 4 feet, according to the manner of using them. These shafts were pointed with bone or buck-horn, inserted in the working end as represented in Fig. 1, bound with sinews, or rawhide thongs, to prevent splitting. For some kinds of work the bone or horn tips were scraped to a rather blunt point, others with a slightly rounded end of about one-half inch in diameter. He described various ways of holding the stone while the pressure was being applied. A water-worn pebble broken transversely was commonly held by being sufficiently imbedded in hard earth to prevent its slipping when held by the foot as the pressure was applied. Large blocks of obsidian or any easily flaked stones were held between the feet of the operator while sitting on the ground, the *impulsive pressure* being given to the tool grasped in both hands, a cross-piece on the upper end resting against his chest, the bone end against the stone in a slight indentation, previously prepared, to give the proper angle and to prevent slipping.

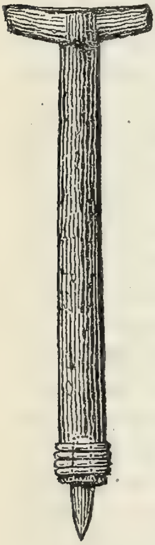


FIG. 1.

In some cases the stone operated on was secured between two pieces or strips of wood like the jaws of a vise, bound together by cords or thongs of rawhide; on these strips the operator would stand as he applied the pressure of his weight by impulse. The best flakes, outside of the home-made, were a subject of commerce, and came from certain localities where the chert of the best quality was quarried in sheets or blocks, as it occurs in almost continuous seams in the intercalated limestones of the Coal Measures. These seams are mostly cracked or broken into blocks, that show the nature of the cross fracture, which is taken advantage of by the operators, who seemed to have reduced the art of flaking to almost an absolute science, with division of labor; one set of men being expert in quarrying and selecting the stone, others in preparing the blocks for the flaker. This was done when the blocks were nearly right-angled at the corners, by striking off the corner where the flaking was to commence, and, with a properly directed blow with a hard pebble stone, knock off of the upper edge a small flake, making a seat for the point of the flaking tool. Sometimes these blows were carried entirely across the front upper edge of the block, making a groove entirely across the edge, when the first row of flakes have been thrown off. It is the work of this operator to prepare seats for a second row, and so on. What was meant by almost absolute science was a knowledge and skill that would give the proper direction to the pressure to throw off the kind of flake required. Fig. 2 represents, as nearly as I recollect, the rude sketches made of the flaking tool used to throw off massive flakes, when a sudden percussive pressure was required in addition to the impulsive pressure the man could give. The staffs of these flaking tools were selected from young hard-wood saplings of vigorous growth. A lower branch was utilized, as shown at *a* in Fig. 2, to form the crotch in which the blow was struck. Another branch on the opposite side, *a*, was used to secure a heavy stone to give weight and increase the pressure. When the stone to be flaked was firmly held, the point adjusted to give the pressure in the required direction, the staff firmly grasped, the upper end against the chest of the operator, he would throw his weight on it in successive thrusts, and if the flake did not fly off, a man standing opposite would simultaneously with the thrust give a sharp blow with a heavy club represented in cross-section *b* in Fig. 2, it being so shaped that its force is downward close in the crotch. It has been represented to me that a single blow rarely failed to throw off the flake, frequently the entire depth of the block of stone, sometimes as much as 10 or 12 inches. The tooth or tusk of the walrus was highly prized for tips of the flakers.

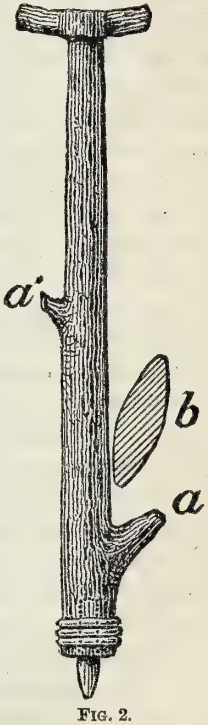


FIG. 2.

What I have thus far written is at second hand, being merely recollections of conversations at various times with the parties I have referred to, and more recently with a man who for over thirty years had been connected with a fur company, and who had lived most of that time among the Indians, and much of it, as a trapper.

What I now propose is to give some of my experimental practice in flaking and working flint (chert), and (from a purely mechanical standpoint) some conclusions drawn from a pretty extensive examination of the waste and refuse as well as finished and partly finished work left in the aboriginal flint workshops.

There are many places along the banks of the Ohio River and its tributaries that are not subject to the annual overflow, but are still below the occasional great floods, where the flaking process has been extensively carried on, and where cores and waste chips are abundant. At one of these places, on the Kentucky side of the river, I found a number of chert blocks, as when first brought from the quarry, from which no regular flakes had been split; some had a single corner broken off as a starting point. On the sharp, right-angled edge of several, I found the indentations left by small flakes, having been knocked off evidently by blows, as described by Catlin, as a preparation for seating the flaking tool. Most of the localities referred to are now under cultivation, but before being cleared of timber and subjected to the plow, no surface relics were found; but on the caving and wearing away of the river banks, as the light earth washed away, many spear and arrow-heads and other stone relics were left on shore. After the land had been cleared and the plow had loosened the soil, one of the great floods that occur at intervals of some fifteen or twenty years, would wash away the loose soil, leaving the great flint workshops exposed. It is from the stores of material left, the cores or nuclei thrown aside, caches of finished and unfinished implements and flakes, the tools and wastage, vast accumulations of splints, &c., that we can, on critical examination, draw tolerably correct ideas of the mode of working pursued.

One of these great flaking banks or workshops is exposed on the northern bank of the Saline River at its first rock "ripple," about 3 miles above its junction with the Ohio, the general course of the Saline being from the northwest to the southeast. Above the "ripple" the stream is only navigable during high water of the Ohio. On its southern side are ranges of hills from its mouth to its source, ranging between 300 feet and 400 feet in height, and on the divide between the west fork of the Saline and Eagle Creek they rise to a height of over 800 feet. The ridge is broken through by the valleys of small tributaries; the spurs from the ridge at places terminating in rock bluffs close to the river, at others leaving a narrow bottom. On the northern side of the stream the hills proper commence about 4 miles above the mouth, leaving a wider valley or bottom on that side; the low bottom lands of the Ohio extend nearly to the ripple, where commences what is termed the second bottom lands of the Ohio, which rise rather abruptly, extending with the river by its windings at varying distance from it. It is on this ridge where it is intersected by the Saline that the coal company made the terminus of their railroad and shipping port of coal.

On my first visit, in the fall of 1853, this was in dense forests with the exception of a narrow strip along the bank of the Saline, which had been cleared for railroad coal dump, saw-mill, shops, and dwellings. The most of the cleared portion was a range of low sepulchral mounds crowded together. In cutting into them for foundations, small sized stone cists were exposed, none over 4 feet in length, with a single exception; this was (in excavating foundations for saw-mill boiler in the side of the largest of the mounds,) a skeleton at full length, surrounded by and covered with thin sandstone slabs, much as the small cists were formed. With this skeleton were found two small clay pots, some shell beads, a flint gun-lock, barrel, and metal trimmings of an old English musket, the stock so decayed that it fell to pieces when being taken out—no doubt a recent surface burial; in fact, human bones were found near the surface of all these mounds. The small cists over which they were originally raised contained nothing but fragments of bones, teeth, and occasionally a stone celt and a few flaked implements. The first indication of relics on what has proved to be a great stone implement manufactory was in sinking a cistern on the ridge about 200 yards from the river. This went through a mass of flint chips. By the year 1859 the little clearing around the house where the cistern was sunk had joined with the cleared strip on the river banks, making in all a clearing of some 25 acres. Heavy rains after the first plowing exposed some few specimens of spear and arrow points; the next plowing, a still greater number. But it was not until the great flood of the winter of 1862 and 1863 that overflowed this ridge some 3 or 4 feet, with a rapid current, that the portion under cultivation north of the mounds on the river bank was denuded, exposing over 6 acres of what at first appeared to be a mass of chips or stone rubbish; but amongst it were found many hammer stones, celts, grooved axes, cores, flakes, almost innumerable scrapers, and other implements, pieces of broken, much-decayed bone, but no perfect bone implements, many tines of the buck or stag, all of which bore evidence of having been scraped to a point. On exposure to the air they fell to pieces. Among this waste it was rare to find fragments of rude pottery, though they abound among the mounds near the river bank, and further north on the same ridge, where burnt sandstones, black earth full of fragments of shells and bone, show the site of a settlement—the field being nothing but a workshop. The great August flood of 1875, and the winter floods of 1881, 1882, and 1883 continued the work of denudation until the ground became unfit for cultivation, and was abandoned. The greatest number of cores, scattered flakes, finished and unfinished implements, are of the chert, from a depression in a ridge 3 miles to the south-east, where there is evidence of large quantities having been quarried. I have found a few cores of the white chert from Missouri. and the red and yellow jasper of Kentucky and Tennessee; but the flakes of these have mostly been found in nests or small caches, many of which have been exposed, and in every case the flakes they contained were more or less worked on their edges, whereas the flakes from the neighborhood chert preserved their sharp edges as when split from the mass. These cache specimens with their worked serrated edges would, if found singly, be classed as saws or cutting implements. But here, where found in mass, evidently brought from a distance, to a place where harder chert of a much better character for cutting implements abound, they tell a different story. No two are exactly alike, yet the work on all is of the same character, and evidently done for the same object. To one discovering that object, they tell the story clearly, as well as the mode of working, written on stone, and better than it can now be told either by writing or illustrations.

To make myself understood I must have recourse to sketches, and then will most probably fail to make it as clear to the general reader as these stone flakes do to me. Let us first look at a flake as detached from the mass, and study its nature, presuming it to have been flaked from a stone that by a hammer stroke would break with a fine-grain conchoidal fracture. Fig. 3 is a plan view of the outer or high side of an ordinary flake intended for a spear or arrow-head; the shape of this high side depending on the lines of fracture of the previous flaking. Fig. 4 is a section through the center of the flake on the dotted line *a a′*, showing its flat side and sharp edges. Fig. 5 an edge view, showing at its upper end the angle of the recess formed, and against which the point of the flaker had been pressed to throw off the flake; dotted lines in the cross-section Fig. 4 show the form of an arrow-head on the line *a a′* that the flake will work into. The form of the head is given by dotted lines in Fig. 3. From these it will be seen that the portion of the flake to be chipped away (and also the greatest portion of the chipping to be done) is from the flat side.

(Half size.)

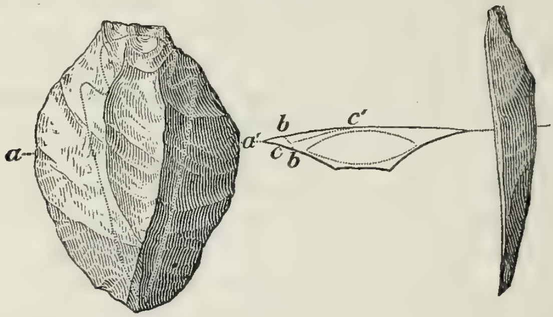


FIG. 3. FIG. 4. FIG. 5.

The man who makes the flake can at a glance see what it will best produce. His flakes are for transportation; bulk and weight are serious considerations. His practical eye tells him how to reduce them into the best merchantable form; and the greater number of the flakes found in the caches alluded to have been so worked, and always from the flat side of the flake. This could not be accidental. By referring to the axis line in section Fig. 4, the amount of chipping from the flat side that has to be done will be seen. To attempt to do this and to throw off long chips from the sharp edge of the flake would prove a failure, as its sharp edge would either crumble away or it would cut and injure the point of the bone flaker without throwing off the desired chip or flake. Experience has taught the operator the best shape of edge to apply the pressure to accomplish his object, and it has also taught him how to reach it in the simplest possible way. A spoon-shaped hollow on the top of a flattened log, or even a gutter or groove cut in it, furnishes the means of holding the flake firmly, the raised or high side placed in the hollow, the flat side up; with the ends of the fingers of his left hand pressed on it he holds it firmly, while with his right hand a downward pressure is given by the flaking tool which breaks off chips with a fracture of about 45 degrees from the flat surface, leaving the edge in the best possible shape for future work, and that is the condition of these cache flakes as they are found.

In old times, before the invention and introduction of planing and shaping machines to work metals, the first and most important lesson taught to the machinist's apprentice was the use of the hand-hammer and cold-chisel. When an outer shell was to be removed from a metal casting and its surface left in condition to be finished by file or scraper, the smoothness and regularity of that surface was essential, not only for economy in working, but accuracy of the file finish. The apprentice was taught to hold his cold-chisel and so direct the strokes of his hammer that when a chip was started the chisel should hold to it, and not be allowed to cut too deep or slip and fly out, leaving a shape that is difficult to start a fresh cut without leaving ridges or cutting deeper, in either case causing additional labor for the finisher.

To a practical mechanic the examination of such a flint workshop as I have described—its waste chips to the partly worked flakes, the roughed out blocks, and the finished implements—reveal a line of workmanship so clear that it can be followed to the production of the same results.

The handling of the tool and flake to form an arrow-point is as much an act requiring exactness and precision as the handling the cold-chisel and hammer is to the machinist. The first chip thrown off is analogous to the first starting work of the cold-chisel; it is the text that must be adhered to to the end of the chapter. Holding the flake in such position that commencing at what is intended for the point of the intended work, the pressure with the flaking point is brought to bear close to the edge of the 45 degrees angle and at right angles to it; the result is a flake thrown off inclining towards the stem end of the arrow-point. In sectional sketch Fig. 4 from *a* to *a′* shows the 45 degrees angle left by the first rough shaping from *c* to *c′* the direction of the first chip thrown off. The seat left by this chip when thrown off is concave on the edge of the flake, the advance corner of which is the seating point for the tool to throw off the next chip, which does not entirely obliterate the concave of the first, and the following chip leaves a serrated edge, the chips or flakes being generally parallel, which is the object of a good workman to make them. When the flat side by chipping has been reduced to nearly the required form, its edges are in the best possible shape for chipping the opposite or high side, then by alternate working from side to side the point is finished, either leaving it with serrated edges or by after delicate work throwing off the points, leaving a smooth, sharp edge. The indentations at the base either for barbs or for thongs to secure the point to its shaft are made by direct down pressure of a sharp point working alternately from side to side, the arrow-point being held firmly on its flat face. From the narrowness of the cuts in some of the specimens, and the thickness of the stone where they terminate, I have inclined to the belief that at the period they were made, the aborigines had something stronger than bone to operate with, as I have never been able to imitate some of their deep, heavy cuts with it; but I have succeeded by using a copper point, which possesses all the properties of the bone, in holding to its work without slipping and has the strength for direct thrust required. A soft iron or thoroughly annealed steel point answers even a better purpose. As yet no copper has been found on this flaking ground, though a few copper beads and remnants of what appear to have been ornaments have been taken from mounds on the ridges of the Saline, which I think is evidence that they had that metal at the earliest time work was done on this flaking bank.

Bryce Wright in his description of the Scandinavian knives or daggers refers to them as being most beautifully dentilled with parallel flaking and serrated edges. He says: "These knives or lances are true marvels of pre-historic art, and show an amount of skill and workmanship which cannot be imitated in the present age, the art of fashioning them having been entirely lost." Sir John Lubbock, on page 104 of "Prehistoric Times," says: "The crimping along the edge of the handle is very curious." As to parallel flakings with serrated edge, I have endeavored to show (from a mechanical stand-point) that the refuse of the great flint quarries points to a mode of working that must leave the dentilled markings parallel, and the edges worked from, serrated. What Lubbock speaks of as curious crimping on the edge of the handles is but the natural result of the mode of working I have examined these Scandinavian dagger handles, and find the same appearance on the blades of large-size broken piercers, numbers of which I have found among the rubbish, picked up, examined, and thrown away as imperfect specimens. Some of them have a spread, flat end or handle of over 1½ inch, with nearly square blades, evidently having been worked by down pressure from the edges corresponding to the spread end, these 45 degrees flakes meeting form angles and produce the square. The interlocking of the flakes at their meeting causes the crimped appearance, in some cases not unlike a row of beads, very beautiful, but not made with any such view, but simply the natural result of the mode of working.

Here also are found massive flakes or chips of fine-grained quartzite, that teach another lesson to a seeking practical mechanic, nosing about among the accumulated refuse. These flakes are often rough on one face, showing them to be an outside scale from the stone; occasionally, fragments of large flat implements that have been classed as agricultural (hoes or spades). These fragments have not been broken by want of skill in the workmen, but from undiscovered seams in the stone that did not show until the outer surface was thrown off. None of these fragments show any sign of use; in fact, some of them have not been wrought to an edge. I have several specimens of hoes from the same ridge beyond the settlement where it would naturally be cultivated, that from their highly polished working ends show long use. The lesson is that they are not made from great flakes, but rather represent the core from which flakes have been thrown off. Finished hoes and spades frequently have portions of natural stone partings that have not been worked off, and show them to have been worked from thin slabs. These slabs are a metamorphic thin bedded sandstone, belonging to what our State geologist, Prof. A. H. Worthen, calls the Chester group. They occur near the Saline, about 8 miles above the flaking ground, in an upheaval that has brought them to the surface with the upturned edges of the carboniferous limestone through which the salt springs flow. This is probably the source whence this quartzite was obtained, as slabs from 1 inch to 2 inches thick are found there; but there are many other locations stretching across Southern Illinois to the Mississippi River where they also occur.

It is the large agricultural implements that I refer to as having been made from quartzite slabs, some of which are as much as 16 inches long by 6 inches and 7 inches wide at the spade-blade end. There are many smaller specimens of the same form and character that have been regularly flaked from chert, white waxy quartz, yellow and brown jasper, that do not exceed 6 or 7 inches in length, their working ends highly polished by long use in digging. It is the large hoes and spades flaked from quartzite slabs that to me are evidence of a much higher degree of intelligence and skill than the most highly-finished spear and arrow points evince. Take an edge view of one of these large spades, and observe how accurately straight and free from wind the edge has been carried entirely around the implement, the flattening of one side and rounding the other; then observe that the long flat very slightly depressed flakes have been thrown off at right angles to the edge, even to those curving around its digging or cutting end, which appear to have radiated from a common center. If these flakes have been thrown off by blows so struck and directed as to preserve the cleanly lined edges, as the operator had carried them in his mind, a skill must have been acquired that we cannot approach.

In all the experiments that I have tried with a hammer, whether of stone, steel, soft iron, or copper, they have failed to produce the desired result; the seat of the flake is more conchoidal, shorter and deeper depressed, whereas the direct *percussive pressure* throws off the shape of flake that we find has been done in making these spades. If this mode has been resorted to, it necessarily required considerable ingenuity in devices for holding the stone slab firmly, while the pressure was being applied in the right direction. The wooden clamp described by Catlin may have been used. The simplest device that occurs to me that will answer the purpose is a block of wood planted in the ground, with its end grain up, cut on top into steps, as represented in sketch, Fig. 6, the lower step having grooves parallel with the rise of the upper step; in one of these grooves the edge of the implement is placed, its back resting against the edge of the higher step, as represented by the dotted lines showing the form of a spade. When in this position, presenting the proper angle to the operator, a man holds it firmly while another applies the pressure. A lower step, *e*, with the back edge of top are hollowed out to receive the work, while its lower end rests in an indentation in the lower step. In this manner a spade can be firmly held while its cutting end is being flaked. I do not present this as a mode that was practiced, but as a device that answers the purpose, and I judge to be within the capacity of the ancient flint-workers, of whom there is nothing left but their chips and finished work.

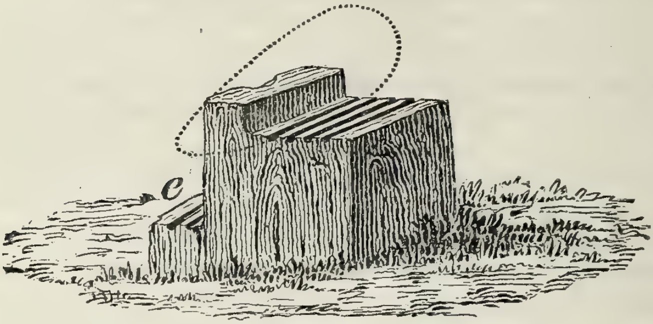


FIG. 6.

Let any one experiment with a bone point in chipping flint; he will soon discover the value of a *dry bone*, a bone free from grease that will hold to its work without slipping, a bone with sufficient hardness to resist abrasion, a bone of strength to bear the pressure, and he will value such a pointed bone, and will understand why, with such a bone, John Smith's ancient arrow-point maker "*valued his above price, and would not part with it.*" I have been informed that the modern Indians free their flaking-bones from grease by burying them in moistened clay and wood ashes, not unlike the common practice of our housewives to remove grease spots from their kitchen floors.

The hunter or trapper described to me a mode still in practice among the remote Indians of making flakes by lever pressure combined with percussion, that is more philosophical and a better mechanical arrangement than by the use of a flaking-staff, as described by Catlin. Figure 7 shows the manner of utilizing a standing tree with spreading roots for this purpose; a flattened root makes a firm seat for the stone, a notch cut into the body of a tree the fulcrum for the lever; either a pointed stick is placed on the point of the stone where the flake is to be split from it, its upper end resting against the under side of the lever, or a bone or horn point let into and secured to the lever takes the place of this stick. When the pressure is brought to bear, by the weight of the operation, on the long end of the lever, a second man with a stone, mall, or heavy club strikes a blow on the upper side of the lever, directly over the pointed stick or horn-point, and the flake is thrown off.

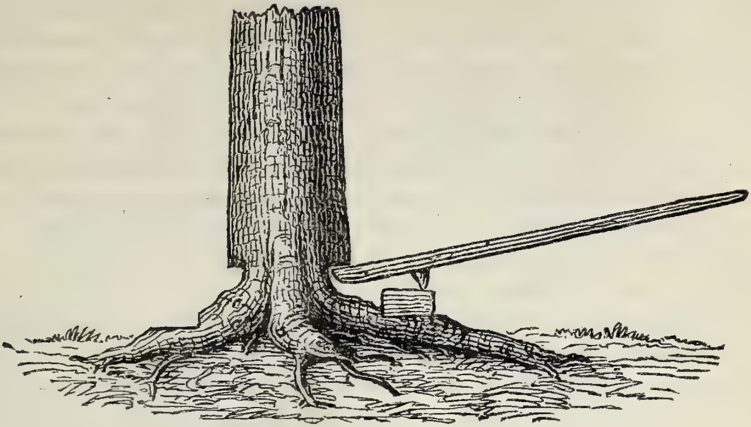


FIG. 7.

Lubbock, in "Prehistoric Times," illustrated the Eskimo scraper as used at the present time in preparing skins. When we consider the close proximity of the flint workshop to the great salt licks on the Saline River, the flowing salt springs, the deeply worn buffalo paths still to be seen after having been subject to the destructive work of cultivation by the plow for more than a generation, where skins by the thousands must have been dressed, it is not surprising that the many chert flakes that have been split off with too great a curvature of their flat side in their length to admit of being chipped into arrow-points should have been utilized for scrapers, many of which are the exact *fac simile* of what Lubbock has illustrated as the Eskimo and others of the European type, of which he says:

"It is curious, that while these spoon-shaped scrapers are so common in Europe, they are very rare, if indeed they occur at all, in North America south of the Eskimo region."

I think it most probable from their close resemblance to refuse flakes and chips they were overlooked by early collectors. In the great game districts of the West, both in flint workshops and among the waste of Indian settlements, they are much more abundant than arrow-heads, or any other implements, with the exception of the small flint knives.

It is also in these game districts that what is known as the "bevel-edge arrow-points" are found, that have been a subject of much discussion as to their use. Foster says of the one he has illustrated: "The specimen represented is from Professor Cox's collection, and the two edges are symmetrically beveled, as if to give it a rotary motion." I have met many others that accept this idea, unmindful of the fact that a ship is not steered at its stem, but by the rudder, at its stern, and an arrow is not directed or held to its course by its point, but by the feather at the butt end of its shaft; and if a rotary motion was required it would naturally be given by placing the feathers spirally around the shaft. The broat flat sides of these beveled points would neutralize any effect from the short bevels in passing through the air.

I have heard it urged that they were reamers, and that the uniform bevel being in one direction, to cut as reamers they would have to be turned to the left, or, as our workmen say, "against the sun." From this it has been argued that the people who used them belonged to a left-handed race. The direction and uniformity in the bevels is to me evidence of exactly the reverse. Among all the points we find they are the simplest and easiest to form by chipping when laid on their flat. Nothing but the down pressure of flaker is required to separate a chip from a flat at a 45-degree angle. Suppose a flake that had been roughly shaped held flat on a block of wood by the fingers of the left hand, the tool in the right hand chipping from the point to the broad end by direct down pressure; then by turning the flake over and working the other edge in the same manner, we have in a center cross-section a form resembling a long-stretched rhomboid with sharp cutting serrated edges at the acute angles.

Colonel Long said that 2 inches was the greatest length of stone arrow-heads that he found in use among the Indians; that all longer not used for javelin and spear-heads were strongly hafted and used as cutting implements. This was confirmed by Catlin. It is more where and under what circumstances we find a stone tool than the tool itself

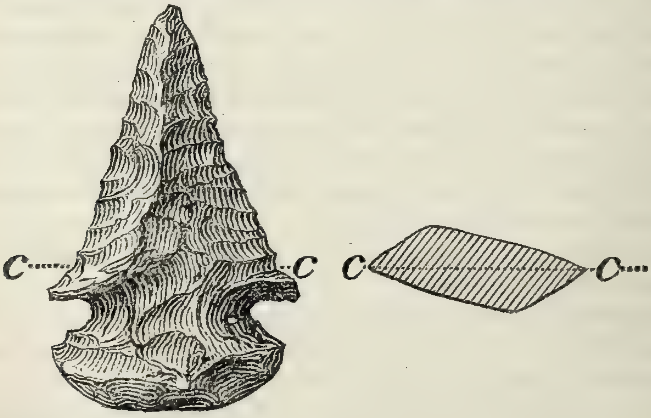


FIG. 8

that teaches its probable use. In the case of the bevel-edged points, all I have found have been among waste where the users have lived, done their cooking and skin-dressing; and these were always associated with broken bones, muscle shells, fragments of pottery, flint knives, scrapers, &c., never scattered as if lost in hunting, as we find arrow-heads. One peculiarity of the bevel point is its strong, massive shank to secure it to a shaft or handle. This is shown in Figs. 8 and 9, with their cross-sections on the dotted lines; they are both of very dark, hard chert. Fig. 10 is from Bath County, Kentucky, near the Upper Blue Lick; it is of beautifully striped jasper; two sections are given to show the great thickness to give strength to the cutting-edges Fig. 11, yellow jasper; the want of symmetry in form is most probably the result of sharpening by fresh flaking. Fig. 12, a beautiful specimen of workmanship, showing a different mode of attachment to a handle. All the above are drawn full size.

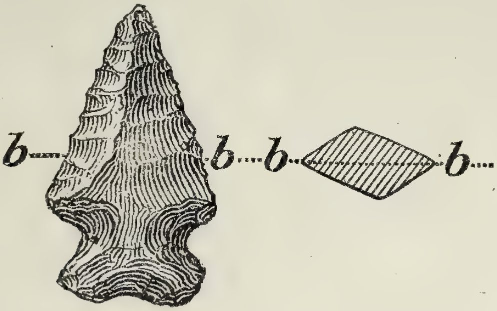


FIG. 9.

(Half size.)

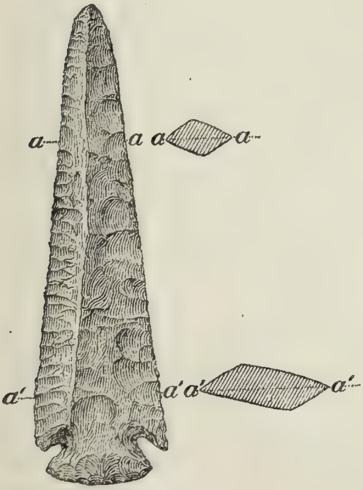


FIG. 10.

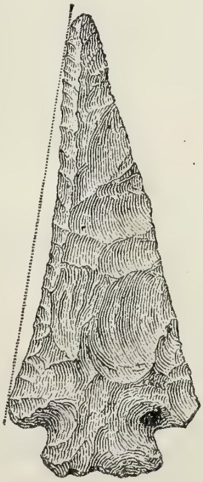


FIG. 11.

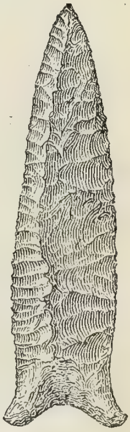


FIG. 12.

In a small cache of leaf-shaped implements were found six of the bevel-edged points, all broken off at the shank in precisely the same manner,—pretty conclusive evidence of hard service, and probably brought to the workshop to have new shanks formed and to be re-hafted.

The only effort at drilling or piercing that I have found among the rubbish is a piece of yellow fluorspar 2 inches long, roughly rounded to 1¼ inches diameter; in one end a hole one-fourth inch in diameter has been drilled three-fourths inch deep; at the other end, a hole one-eighth inch diameter and only one-fourth inch deep. Many pierced implements have been found at or near dwelling sites associated with this flint manufactory, such as banner stones split through the drilled eye; some split fragments of tubes of great length, made out of hard schistose slate.

Among the waste are pieces of specular iron ore from Missouri, in evidence that it was worked here, probably into axes and weights or plumb-bobs. There is also evidence that argillaceous iron ore, the clay iron stone or carbonates of the coal measures, was a material extensively used. From the various forms of much oxidized pieces that I have found that will not bear handling, they appear to have been cutting or carving tools, probably used in the manufactories; though axes and celts made from this material are occasionally found in the vicinity of the salt licks, always deeply oxidized, peeling off in flakes that conform to the original form of the implement.

Many scooped or hollowed out blocks of sandstone or large flattish river bowlders, mostly sunk on both sides, that are classed as mortars for crushing corn, and with them crushing stones and pestles, have been plowed up on this flaking ground, but they are much more abundant on the dwelling portion of the ridge; also river pebbles partly pecked to an edge for celts, some of them roughly grooved for axes; but what surprised me most was the great number of what have been called cup-stones, by some nut-stones. These are frequently found scattered over Southern Illinois and Western Kentucky, and occasionally on all the tributaries of the Mississippi. But here they are found in mass. When the ground was first put under cultivation none were seen, and it was not until the great denuding floods had passed over it that they were exposed. On finding, just above the surface of the ground, the face of a fine specimen that showed a number of cups, I loosened and turned it over to examine the cups on the under side, and found it was lying on top of another. With pick and spade I soon exposed a group or pile of over twenty, and with them a number of slabs of the same sandstone that showed marks of having been used as rub or grind-stones, all from the millstone-grit series from the bluffs on the opposite side of the Saline. Further research developed a number of such piles, some only having the cup-like indentations, as illustrated at page 40 of No. 287 of the Smithsonian Contributions to Knowledge; others having a center depression of from 4 to 6 inches in diameter, similar to the rude mortars with the cups irregularly arranged around them. Subsequent overflows exposed many scattered over the entire flaking ground; they varied in size from large pebbles with a single cup on opposite sides, known to the early settlers as having been used by the Indians as nut-stones, up to massive slabs, having from two up to eight and ten cups on a side, some too heavy for me to lift into my wagon without assistance (the largest I have seen was taken from near the center of a large mound in Bath County, Kentucky; it had twenty-seven cups one side and a greater number on the other). Many have been carried away from the flaking ground and used as cornerstones for log cabins or built into hearths and fire-backs to their wooden curb fireplaces, with their stick-and-clay daubed chimneys. So many being found where the manufacturing of stone implements has been so extensively carried on is suggestive to a mechanic that they were either made on the ground and kept on hand for sale, or they were tools in some way used in their works. That they were newly made can hardly be the case, for very frequently one cup has been worn into another. This, considering their sharp grit, rather points to some grinding process. Had they been for paint receptacles or pallets, we would expect to find them at dwelling places (where the Indians would naturally do their dressing and painting), and not in their workshops.

On the opposite side of the Saline River, due south of the flaking bank, a spur from the main ridge terminates abruptly by a very steep descent to the bottom lands, which at this point have a breadth of about 50 yards; at the foot of this bluff are masses of sandstone; they also project out of the steepest portion of the earth (at a time long past about 100 feet high), from the top of which the ascent is gradual to the crown of the ridge, forming a beautiful inclined plateau extending with the ridge until it is lost by steep inclines into the valley of the Little Saline, a small tributary that has cut through the ridge and falls into the Saline 1½ miles above its junction with the Ohio, and midway between its mouth and the first ripple. This plateau, when I first saw it, in 1854, was covered with heavy timber, many trees being from 5 feet to 6 feet in diameter. The broad valley of the Little Saline had some portions that are above the ordinary overflows cleared and under cultivation as early as 1834. The slope from the ridge to the Saline, including its bottom lands, have been under process of clearing since 1859. After the plow had loosened the soil, and it had been washed by the rains, both the slope and thebottoms have been rich in stone relics, the bottoms—particularly, in the agricultural implements of the Mound Builders. Climbing the steep directly opposite the flaking bank, chips of chert are found mixed through all the soil that has been worked from above, changing the rock bluff into the present steep incline, on the top of which on its turn from the steep to the gradual slope, another flaking place has been exposed. There within a space of two acres and not over an hour's tramp, on the fresh-plowed earth, I found scattered over twenty specimens of the cup-stones, which I collected and piled in a heap. This is another instance of their having been left among the offal of a workshop.

In the valley formed by the junction of the Big and Little Saline, occur extensive earth-works, long walls, mounds, &c. The largest of the mounds has a height of 25 feet, length of base 225 feet, and width of 175 feet; its oval, truncated top is about 35 by 70 feet; its direction lengthwise is north 12 degrees west; it has a graded way on the east side, and was originally faced with stone; over one hundred wagon-loads have been taken from it and used in walling drains.

The earth-work and mounds extend on to the ridge to within one-fourth of a mile of the flaking ground on the bluff, thus connecting all these works. On the spurs near the Sabine are cemeteries and sepulchral mounds, from which many human bones have been turned out by the plow. I have opened several of the mounds, one of which, from a mechanical point of view, possessed great interest, for the primary interment over which it was raised was that of a worker in stone; and who knows but he may have been at a time the master mechanic or chief superintendent of the great flint works? The center of his mound was paved with the valves of the muscle shells of the Sabine, laid on the levelled surface of the natural soil in concentric rings, with the convex sides up. This shell pavement was about 7 feet in diameter; on its center was a pillow composed of twenty-seven pebble rub-stones of various grit and differently shaped edges. On these the skull was laid on its side; it was far gone in decay and crushed out of shape; the teeth much worn; the position of the large bones that escaped decay showed the man had been bent, bringing his knees near his chin, and laid on his side. He was a man of massive frame; the femur measured 19 inches and the tibia 15¼ inches long. Close to the crown of his head stood a rude clay vessel, badly broken; in front of the skull, on the rub stone pillow, a gorget, finished with the exception of drilling hole for suspending it, on which lay a plumb-bob, a stag's tine scraped to a point; this broke to pieces on removing it. There were some bone splints, two canine teeth of a wolf, some pieces of galena, one crystal of mica one-half inch thick (the plates had not been parted), a few chert flakes, and a single finished arrow-point: on the shell floor of the mound, near its outer edge, one of the mysterious cup-stones, with three cups on one side and four on the other. I could not see that it had been placed with any reference to the center skeleton, but close to it, on the shell floor, lay a small-sized skull in a better state of preservation than the central one. A large hole in the back of it showed it had been crushed in, the broken portions either having been removed or decayed. Close to it lay the deadly slingstone, of roughly shaped chert. The decayed and broken bones of this skeleton had been thrown out in removing the earth from the shell floor, so that its position could not be accurately ascertained, though from portions of bone still remaining after the skull was discovered it was evident that the entire skeleton lay on the shell floor, and close to the central one, and was no doubt a primary interment.

Among these earth-works, where the densest aboriginal population have left their marks, stands a farm house and its outbuildings, with its garden on a pre-historic cemetery. From this point radiated the early clearing and cultivation that has been most destructive to the long wall earthworks, and was the place of all others where I expected to find the cup-stones. The single-pit nut-stones and indented hammer-stones were plenty, and also the rude mortars, but the cup-stones were comparatively few.

An aged farmer, whose father with his family emigrated from Virginia into this section when it was Indian territory, and who as a boy worked at the early salt works, tells me that the Indians then here used the single-pit nut-stones, but they did not know anything about the cup-stones. He asked me if I could divine any use for them. On my suggesting grinding he said I was wrong and that he could tell me their use. I will now give his explanation as near as I can in his own language. He said: "If you want to see them in daily use, go to Patagonia, and you can any day see a lot of women squatting around one of these stones spinning yarn and talking scandal. You see, they strip and singe the hair off of a piece of raw hide, lay it on the stone with the flesh side up; they then squeeze it into the cup holes and put something on to hold it while it dries. Then you see every cup makes a step for the foot of a spindle to rest in, and holds just enough grease in it to make the spindle run slick; and, depend on it, that is the way the thread was spun here to weave the cloth that has left its impressions on the pieces of the old clay salt-pans. You know that our Indians did not know anything about them, or of salt either, for that matter; so how could they know what these stones were used for?" I understood him to say that when a boy he learned this from a Pacific whaler, who drifted to the salt works, and who related that on one occasion the vessel he was on laid up for some time in the Straits of Magellan, and that he then saw the Patagonian women using just such stones as steps for their spindles.

If that could have been the use of those that are so abundant here, we should expect to find them where the women dwell rather than at the flint workshops, the same reasoning applying to their use as paint pallets. If used for either of these purposes, why do we find the cup depressions on both sides, and many of the cups of various size, some just started and others worn one into another?

From the fact of the upper stone of the piles as they were left on the flaking ground being covered with such a depth of vegetable mold as not to have been discovered until after cultivation and exposure by the denuding floods, the finding one in the mound with the decayed skeleton of a stone-worker, the one I have before referred to as having been found near the center of a large mound in Kentucky, leaves little room to doubt of their having been, as well as the primeval workshops, coeval with the earth-works and their associated mounds.

There are other evidences of great antiquity in the condition of many of the granite and porphyry implements being honeycombed by the disintegration of their feldspar, leaving the silicious portions rough and projecting. Celts and fleshers made of the carboniferous limestones have the silex skeletons of their fossils sharp and clearly marked.

From the location at the first ripple of the Sabine as a fishing point, the proximity of the salt-licks for the larger game, no doubt the place was frequented, if not permanently occupied, by the last of the Indians in this section, who have left their stone implements scattered broadcast over the country. They had lost value by the introduction of the nailers iron points, the rifle, knives, and the usual stock of the Indian trader. Had not this paper extended far beyond my original intent, I could give an accumulation of evidence of the rapid decline in the art of flaking stone.

From a mechanical stand-point, it is hard, if not impossible, to reconcile the accepted evolution of works of the stone age from flaked to ground and polished implements. It is true that specimens are found in all stages of progress from rough flake to polished implements in America as well as in Europe. But here in America, where the true flint is absent, a greater range of stone has been resorted to, and what we find flaked and afterwards ground and polished are mostly cutting tools, such as chisels, gouges, &c., of chert, jasper, or fine-grained quartzite that will maintain a keen cutting.edge.

For axes, either plain or grooved, the water-worn pebbles of greenstone, granite, or porphyry have mostly been selected. For fleshers, softer stones are common, such as limestone of various qualities, steatite, occasionally cannel coal, and the harder shales of the coal measures have been used for these wedge-shaped implements. But let the material be what it may, the pecking with a hard stone on a water-worn pebble, often found nearly of the required shape, to modify and bring it to a cutting-edge ready for grinding, by simply rubbing with sand and water on a flat stone, only required labor, patience, and perseverance, but not the knowledge and skill requisite to split off the flakes, nor the judgment, steady hand, and correct eye to shape them into the exquisitely symmetrical forms we find them.

I am not writing on or questioning the evidence of the antiquity of man, but simply on the instruments and tools he would naturally resort to, in his primitive state, to sustain life when depending for food, on the waters for fish, the earth for fruits, seeds, nuts, and roots, and on the chase for animals, not only for food, but, what was most essential for his comfort, skins for clothing, sinews, bone, and horn for innumerable uses. With the aid of a sharpened pebble (stone ax) he could attack a forest tree, and by the aid of fire shape its wood to his uses. Most probably scraping came in advance of cutting, and what could be better adapted for this purpose than the sharp edges of fractured flint pebbles?

With the wooden bow and arrow arose the necessity for an arrow-point harder than wood. If bone was used, the pebble scraper was essential. The river drift or gravel bars, when subjected to the grinding and crushing action of drift-logs or rolling bowlders, would furnish many suggestive forms and shapes that a little ingenuity would apply, and out of which would naturally grow the art of flaking.

The streets of Paducah, Ky., are paved with partly rounded, angular, silicious gravel, mostly of jasper. Seeing heaps of this ready for spreading, I was struck by the many forms, mostly highly water polished, that if found on a flaking ground would pass for refuse flakes and rubbish left by the workmen.

On inquiry I was informed that this coarse gravel was from banks on the Tennessee River above the ordinary overflows. I selected many forms that any archæologist would pronounce to be the work of man.

A heavy wagon, loaded with hogsheads of tobacco, drawn by five or six yoke of oxen, passed over the fresh-spread gravel with a sharp, crushing, grinding sound. On examining the wheel tracks I was surprised to find the slight impression the iron tire had made on the surface stones. They had been pressed aside from the wheels, leaving a slight rut, those under the wheels compressed together, but very little broken; not sufficient to account for the sharp, crackling noise made as the wagon-wheels passed over them. On examining the effect from the tread of the wheels to the old road-bed, a depth of about 6 inches, I found most of the larger gravel stones under the top layer split, some into flakes, the fractures in various directions, some crossing others. This spread from the width of the wheel-tires to about three times as wide on the old road-bed. Many of the fresh fractures presented the forms and appearance of genuine cores, and would be mistaken for the work of man. It was a beautiful illustration of the effect of pressure on small points of contact. Our lady friends, often inveterate iced-tea drinkers, when they find a lump of ice too large for their glass, will, with a common toilet-pin between thumb and finger, press its point into the ice, tap its head with the handle of a case-knife, or give it a click with a thimble. The cohesion is destroyed and the ice splits with just such a fracture as is made by impulsive point pressure on the more tenacious and refactory chert.

These Paducah observations led to considerable investigation as to the action of lodged drift-logs on gravel-bars, and finally to an experiment that I should recommend the Smithsonian Institution to try on more extensive scale than I was able to.

I filled a metal cylinder with pebbles of various sizes and shapes, brought a pressure by a screw on them through a plunger; immediately a crepitating sound was heard, which as the pressure increased became sharper and louder, at times almost explosive, as the interstices became filled with broken fragments, producing side pressure and cross fractures. The sound became more confused and died away. On emptying the cylinder, the result was many representations of the rude implements found in the drift.

COPPER IMPLEMENTS FROM BAYFIELD, WISCONSIN.

By Colonel CHARLES WHITTLESEY, *of Cleveland, Ohio.*

In grading the streets of Bayfield, Wis., about the year 1864, the workmen found a copper implement in the gravel. The accompanying figure, one-half the natural size, will give some idea of the shape and character of the specimen (Figure 1). *A* is an upright outline or elevation, with the concave surface toward the rear. *B* is a top view or plan of the implement as seen from above, and *C* a vertical or longitudinal section through the middle at the dotted line *c d.* The irregular space *e e* shows a flaw in the metal.

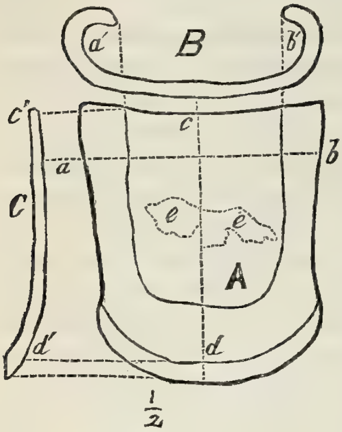
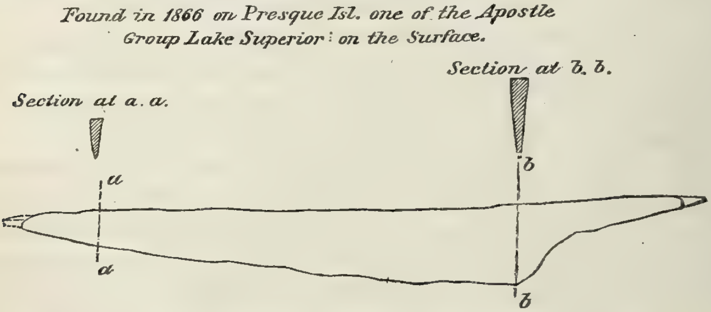


FIG. 1.

Several have been found elsewhere in the United States and Canada of about the same outline, but generally the blade or flat part is much larger in proportion to the shank or socket. Where the two parts are equal they are regarded as spades. One described by Mr. Squier in "Ancient Monuments," taken from a sepulchral deposit near Brookville, Canada, is about 10 inches in length. It could be used in digging by inserting a handle several feet in length, with a notch or offset for the foot near the bottom.

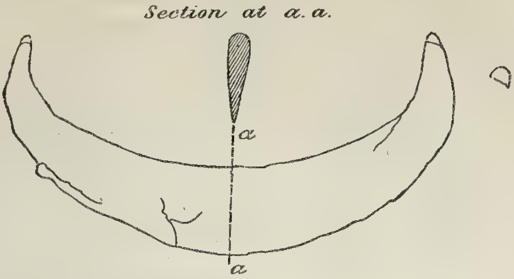
Those with the short bit may have been spades worn out by use. Their edges are generally sharp, as though they had been used to cut wood or some other hard substance. After they were well worn as spades they could be turned into an adze by inserting a crotch, with the plane of the blade at right angle with the plane of the handle, or into an ax by making the planes coincide.


Found in 1866 on Presque Isl. one of the Apostle
Group Lake Superior: on the Surface.
Section at b. b.
Section at a. a.
a
a
b
b

Copper Knife from Bayfield, Wisconsin.

FIG. 2.

Figure 2 represents a copper knife (half-size) found on Presque Isle, one of the Apostle Group of Lake Superior, in 1866. It was lying on the surface of the ground, and is now in the possession of Mrs. E. M. Haywood, of Bayfield, Wis. The thickness near the ends is shown by the cross-sections at *a a* and at *b b*.



Copper Cutting tool from Knife River. Minn.

FIG. 3.

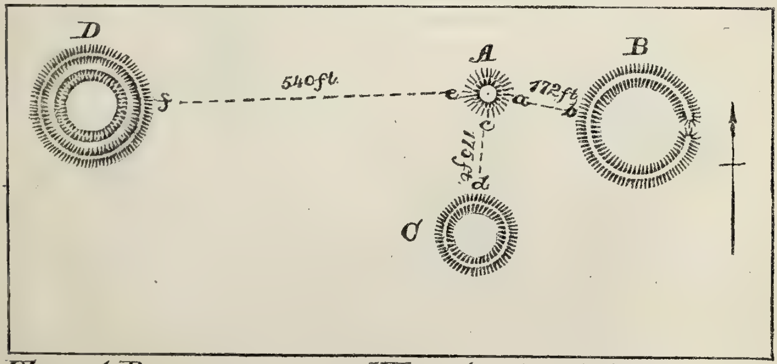
Figure 3 represents a copper cutting tool from Knife River, on the northwest shore of Lake Superior, Minnesota. It was found in 1865, and is now in the collection of the Western Reserve and Northern Historical Society of Cleveland, Ohio. It was evidently cold-hammered, and the surface is rough from corrosion.

ANCIENT REMAINS IN OHIO.

By J. P. MacLean, *of Hamilton, Ohio.*

Works near Winchester, Adams County, Ohio.—Winchester Township is located in the extreme northwestern corner of Adams County, Ohio. The terminal moraine of the great ice age enters the township at the northeastern corner, extends diagonally across it, and passes out at the southwestern extremity. The township, for agricultural purposes, is the richest in the county. The soil, for the most part, is poor, known as cold clay, and the surface broken by the tributaries of Brush Creek.

North of the village of Winchester, a distance of one-half mile, is a series of circular works, which for fifty or more years have been plowed over. Near the center of these works is a mound (*A*) (Plan 1) 8 feet



Plan 1. Remains near Winchester Adams Co., O.

high, conical in form, which has never been disturbed by the plow From the top to the bottom on the east side is 50 feet; from top to circumference on north side 48 feet. East of this mound (*a b*), a distance of 172 feet,is the circle *B*. The wall is almost level with the surrounding surface, although from 6 inches to 1 foot high along the line *g b h*. The remaining part of the work is difficult to trace. The gateway cannot now be located, although it is said to have faced the east. South of the mound (*c d*), a distance of 175 feet, was formerly another circle (*C*), but no trace of it exists at the present time.

West of the mound (*e f*), a distance of 540 feet, is the circle *D*, 150 feet in diameter. This work presents a wall averaging from 10 to 15 inches in height with a ditch in the interior. I was unable to locate a gateway.

When first discovered these works were covered with forest trees. The walls averaged 5 feet in height. The material is composed of clay of the same kind as that in the immediate vicinity. The mound has never been opened. The spot is level, and appears to have been well chosen. Following are the measurements:

(*A*.) Conical mound, 8 feet high; east to top, 50 feet; north to top, 48 feet.

(*B*.) Circle 172 feet east of mound. Circle 510 feet in circumference.

(*C*.) Obliterated circle 175 feet south of mound.

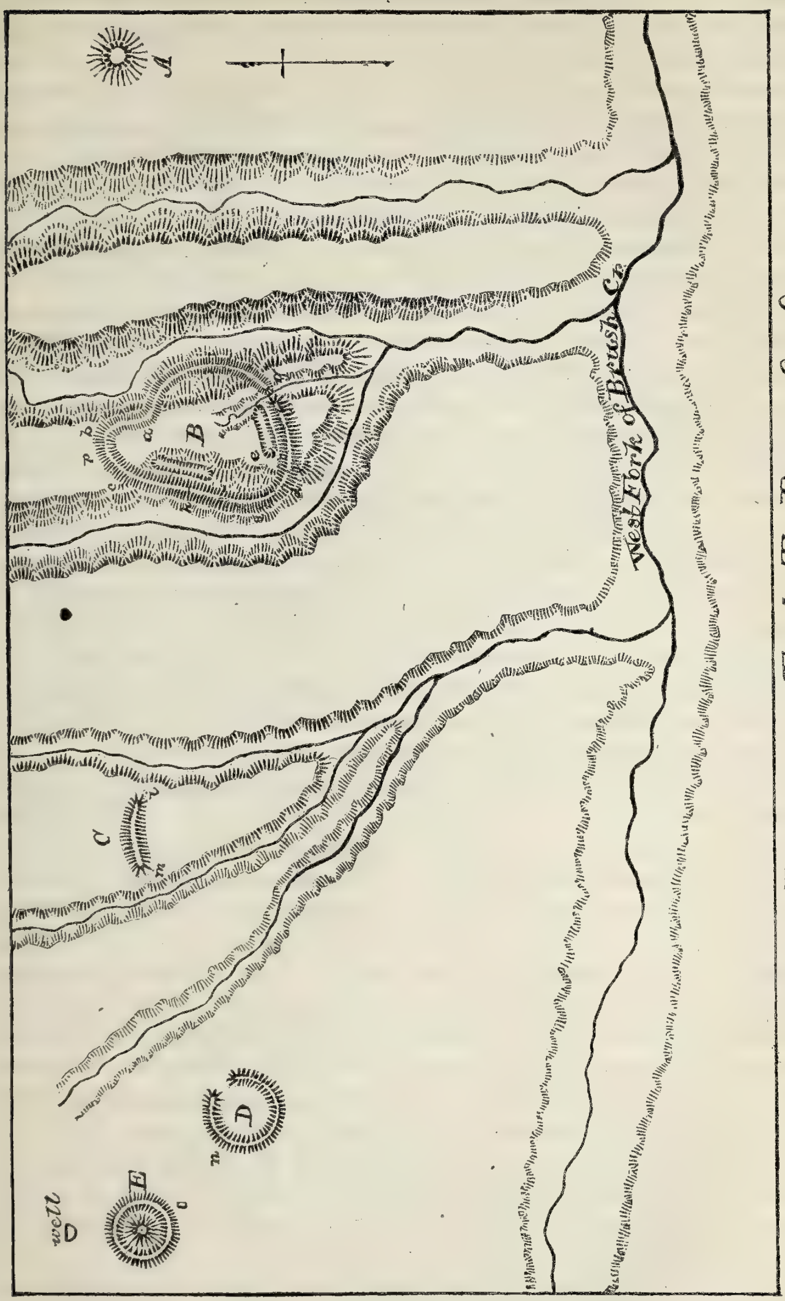
(*D*.) Circle 540 feet west of mound. Circle 150 feet diameter.

One mile and a quarter north of these works, located on a high point of ground, is a mound (Entry No. 3, Map *b*) removed a few rods west of the Hillsboro' turnpike. The mound is conical, 14 feet in height, with a circumference of 250 feet at the base. Original height, 20 feet; solid contents, 2,098 cubic yards. From its summit a fine view of the country may be obtained.

On Entry No. 8 (see map) is a small mound (*c*) 3 feet in height.

Works in Eagle Township, Brown County, Ohio.—Eagle Township (see map) is bounded on the north by Highland County (White Oak and Concord Townships); on the east by Adams County (Winchester Township); on the south by Jackson Township, and on the west by Washington Township. The general surface is comparatively level, although the west fork of Brush Creek has made a deep valley running from west to east. Some of the tributaries of this stream have formed deep ravines. Where these ravines have cut through the glacial till the Hudson River blue limestone is exposed, save in one spot (see map Z, entry 398), I noticed Clinton strata.

The ancient remains located on entries 398 and 1316, in company with Prof. J. W. Fertig, I measured, May 16, 1885 (see Plan 2). The mound *A* is located on the line between Brown and Adams Counties. It is located on a knoll, several of which occur in the immediate vicinity. It is difficult to tell just where the base of the mound begins. If the place I assumed to be the base is the correct one then the mound is 328



Plan 2. Remains in Eagle Tp., Brown Co., O.

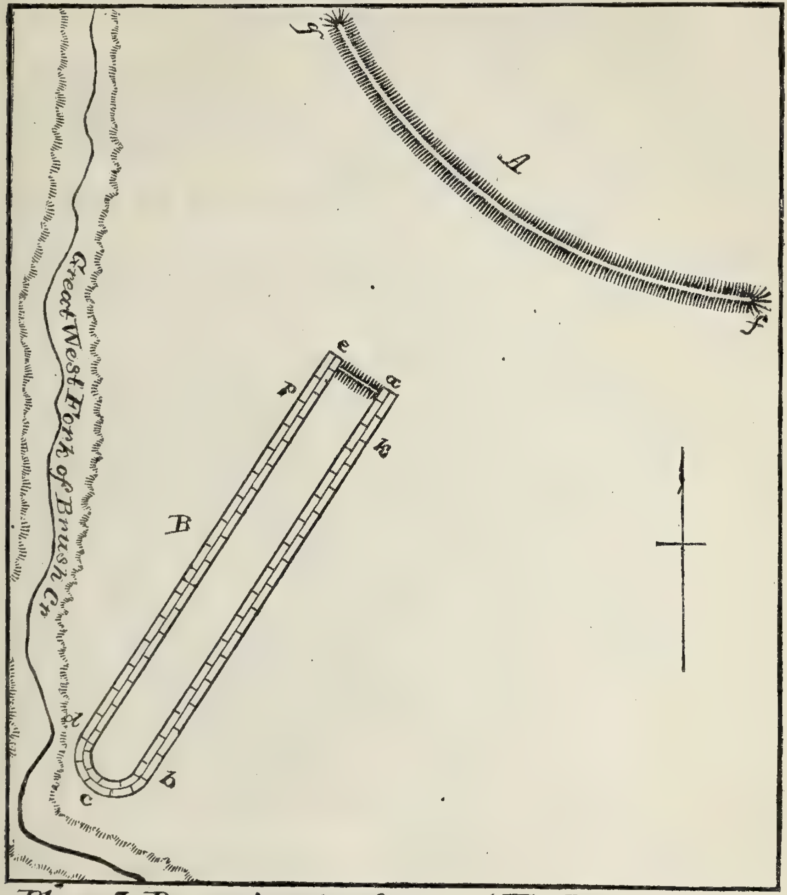
feet in circumference; from northwest base to top, 70 feet, angle 11°; southeast to top, 44 feet, angle 15°; solid contents, 1,533 cubic yards; height, 14½ feet. A view of the country to the southeast is here presented.

Measuring due west and passing through two deep ravines we come to fort (B), striking it at *a*, and removed from the mound a distance of 1,970 feet. This work is entirely surrounded by deep ravines, save a narrow strip of land at the north. That part of the wall marked *p c h d e g* is in woodland. From *p* to *h* the wall is about 18 inches high; from *h* to *d* not over 12 inches, while from *e* to *g* it will average 32 inches. A ditch in the interior extends from *c* to *h*, also from *e* to *g*. The highest point of land is at *p*, thence the wall extends rapidly down the ravine until it is almost level with the bottom at *s*, thence it rapidly rises to *e*, then declines to *g*. From *g* to *a* the wall is entirely obliterated, that part of the work having been under cultivation for the past forty years. From *e* to *b* is a gradual ascent, the distance being 985 feet. The distance from *a* to *b* to *c* to *d* is 1,291 feet; from *d* to *e* 75 feet, and from *e* to *g* 130 feet; from *a* to *b* 300 feet, and from *a* direct to *c* 400 feet; from the point *c* (*B*) we started directly west a distance of 1,875 feet, as we measured it. This number must not be relied upon as being correct. Owing to the density of the underbrush on the west side of the ravine we were forced to deviate from a straight line, but the result was as near as we could reach it without cutting a straight path. At the end of the distance measured, and between two small ravines, on a piece of land sloping to the southeast, is an arc of a circle (*C*) 288 feet in length. The wall has been plowed over for fifty years, yet is 2 feet in height, with a base 20 feet in diameter, and accompanied by a ditch in the interior.

Measuring westward 1,993 feet, and through open grounds comparatively level, we reach the mound *E*. This mound is 332 feet in circumference at the base; from north side to top, 44 feet; from south side to top, 44 feet; across the top, 21 feet; slope angle, 34 degrees; height, 24½ feet; solid contents, 2,516 cubic yards. It is perfectly symmetrical; commands a fine view of the surrounding country; has never been disturbed by plow, pick, or shovel, and is one of the most beautiful mounds in the State. It is surrounded by a circle 160 feet in diameter. The circle, however, is plowed almost down to the general level of the surface. There are indications of a gateway at the east. At a distance of 640 feet southeast of the mound is the circle *D*, 865 feet in circumference. The original height of the wall was 10 feet. It is now about 2 feet, and 40 feet in diameter at the base. The gateway is towards the northeast.

Due north of the mound a distance of about 300 feet was a walled well. The history of this well is not known; it was there when the first settlers came. It has been filled up, and now plowed over.

The whole distance from the foot of the mound *A* to that of *E*, as measured, is 6,526 feet. The figures run 1,970, 1,875, and 1,993. The difference between the two opposite figures is 118 feet. The average distance would be 1,946 feet, while the average of all, including works not given, 2,175. It is more than probable that some system in these measurements was followed.



Plan 3. Remains in Concord Tp., Highland Co., Ohio.

Ancient remains in Concord Township, Highland County, Ohio.—Three and one-half miles northeast of the mound *A* (Plan 2) are ancient remains (see Plan 3) located on Entry 281, Concord Township, Highland County, Ohio. The spot where these works occur is a secluded one. Great west fork of Brush Creek makes a bend almost at right angles. The land slopes from the northeast. Before reaching the creek a bench is met, upon which these works are built. No view can here be obtained of the surrounding country, because it is literally hemmed in by hills. The most interesting work is the stone structure marked *B* (Plan 3). The entire wall, except from *a* to *e*, is composed of Hudson River limestone. The stone has been burnt, and for a long period exposed to the elements. The wall has been thrown down, yet its regularity is perfectly preserved. The following are the measurements: From *a* to *e* (inside to inside of wall), 32 feet; *b* to *d* (inside to inside of wall), 32 feet; *b* to *c*, 125 feet; *e* to *d* to *c*, 165 feet; *a* to *b* to *c*, 165 feet; thickness of wall across base at *c*, 21 feet; thickness of wall across base at *k*, 24 feet; also same at *p*. Height of stone wall, 2 feet. From *a* to *e* the wall is composed of earth, is 8 inches in height and 7 feet in breadth. The floor on the interior of this work is perfectly level.

Fifty-two feet due north-east of this work is a section of a circle (*A*). The wall has been plowed over, and will not average over 1 foot in height by 22 feet across. The distance from *g* to *f*, following the curve, is 225 feet, and on a straight line 130 feet.

Two hundred and eighty-five feet due east of *a* (*B*) is a mound 3 feet high and 22 feet diameter.

At a distance of one-fourth of a mile northeast of (*A*) is another mound located upon a hill, but not having a commanding view of the country, nor of the works just described.

It is fair to assume that the works near Winchester, those of Eagle Township, and the ones just described, belonged to the same people. There is no evidence that they were constructed in different ages and by different people. The nearness of the structures to each other, and their evidently unfinished condition point to the same time and the same people. On a straight line some 6 or 8 miles east is the Great Serpent Mound. This is removed a distance of about 5 miles from "Fort Hill," in Brush Creek Township, Highland County, Ohio. This work has been figured and described* in "Ancient Monuments," with the additional information that "no other remains, except perhaps a few small, scattered mounds, in its vicinity." Near the southern foot of the hill upon which the fort is located is a series of circular works, now almost obliterated.

It is a fair assumption that the builders of "Fort Hill" and the circles near it belonged to a clan separate, yet related to the one that constructed the works near Winchester.

Now, the so-called "serpent effigy" is composed of a frog, an egg, and a serpent. Why may not one of these clans have been the frog, and the other the serpent, or snake; and the series of the effigies represent that the snake clan came from the frog?

Ancient remains in Clarke County, Ohio.—On May 23, 1885, in company with Prof. J. W. Freeman, I visited the works located on the land of Benjamin Newlove, section 29, Harmony Township, Clarke County, Ohio. When these works were first discovered only saplings were growing upon them. The works are situated on the side of a hill descending towards the northeast (see Plan 4). The larger work is oblong, the longest diameter being 320 feet, and the transverse 250 feet. The gateway *a b* is 33 feet; the entire wall is 821 feet long; the wall at *d* is 7 feet

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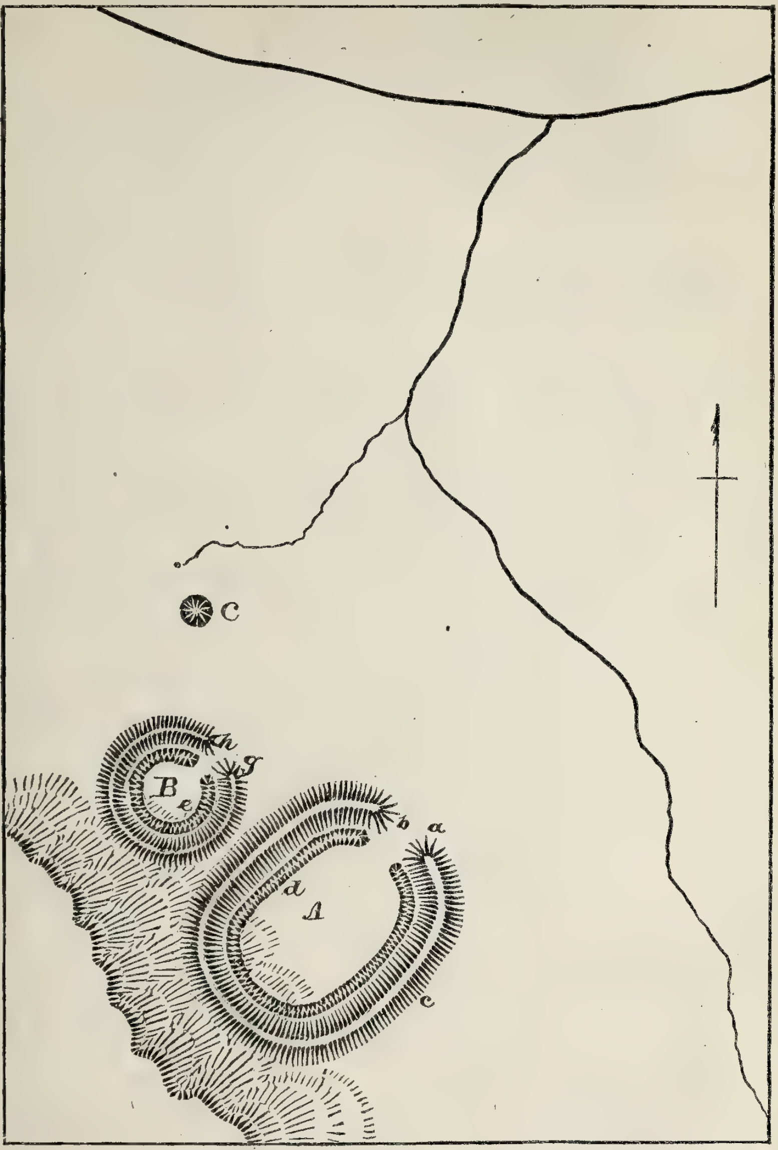
* "Ancient Monuments," page 14.

8 inches high; at *a* and *b* 4 feet high, and 25 feet wide at the base. The width at *c*, 38 feet; at the same point the ditch is also 38 feet across.



Plan 4. Remains in Harmony Tp., Clarke Co., O.

The land at *c* is 15 feet higher than the land at the gateway. The ditch is in the interior, extending the whole distance around save at the gateway. Here the land is perfectly level. The ditch does not touch the embankment. A platform averaging 4 feet across follows between the line of embankment and the ditch.

By the side of the work (*A*) is the circle (*B*). From the bank of one to that of the other at the nearest point is 34 feet. The bank is 560 feet in circumference, to which is to be added 45 feet for the gateway *g h*. The wall is 5 feet high, with a diameter at the base of 25 feet. The work is accompanied by an interior ditch, which, however, does not extend across the gateway. Between the interior foot of the embankment and the ditch is a platform 20 feet in width.

One hundred and forty feet north of the small circle is a circular estufa, walled with small bowlders. Forty feet still farther north is a spring of clear cold water, which has never been known to fail.

A PRIMITIVE STOREHOUSE OF THE CREEK INDIANS.

By CHARLES C. JONES, JR., *of Agusta, Georgia.*

In his description of the customs of the ancient inhabitants of Virginia, William Strachey* says: "Their corne and, indeed, their copper hatchetts, howses, beades, perle and most things with them of value, according to their own estymacion, they hide, one from the knowledge of another, in the grownd within the woodes, and so keepe them all the yeare, or untill they have fitt use for them, as the Romans did their monies and treasure in certaine cellars, called therefore as Plinye remembers, *favissæ*; and when they take them forth they scarse make their women privie to the store-house."

In plate xxii of the Brevis Narratio [Fraucoforti ad Moenum MDXCI], le Moyne de Morgues furnishes a drawing of what, in the accompanying text, is called a *publicum horreum*. It is situated upon the low bank of a river, and toward it canoes—filled with corn and fruits, and propelled by Florida Indians—are tending. Such granaries or public receptacles were, by the peoples dwelling within the limits of the extensive domain then known as Florida, built of stones or earth, and roofed with palmetto leaves and clay. For their location cool spots were selected, where protection was found against the violent rays of the sun. They served as depositories for maize, fruits, nuts, nutricious roots, dried fishes, alligators, deer, dogs, and other jerked meats. Hoards of corn, nuts, and meat are frequently mentioned in the early narratives as existent among the primitive peoples of this region at the time of primal contact with Europeans. They were both public and private.

In alluding to the agricultural occupations of the Southern Indians Mr. Bartram observes: "When the fruits of their labors are ripe and in fit order to gather in, they all, on they same day, repair to the plantation, each gathers the produce of his own proper lot, brings it to town, and deposits it in his own *crib*, allotting a certain portion for the public granary which is called the King's crib because its contents are at his

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[*] History of Travaile into Virginia, p. 113. London. (Printed for the Hakluyt Society, 1849.)

disposal, though not his private property, but considered as the tribute or free contribution of the citizens of the State at the disposal of the King." He further states that the common or public granary served the valuable purposes of assisting the needy when in sore want, of furnishing entertainment for strangers and noted guests, and of supplying warriors with provisions when they were setting out on hostile expeditions.

That the American Indians often concealed in the ground and in secure receptacles not only the products of their agricultural labor and trophies of the chase, but also objects manufactured of clay, shell, and stone, is a fact capable of easy demonstration. Without enumerating the proofs, or pausing to cite authorities in support of the frequent use by the Southern Indians in the sixteenth century of storehouses, both public and private, we desire to call attention to the existence of one of these primitive structures upon the plantation of Colonel Seaborn Jones, at Mill Haven, in Screven County, Georgia. For quite a century it has remained unchanged. It is located upon the declivity of the right bank of Briar Creek, in proximity to that stream, and in the midst of a beautiful forest of oak, holly, and pine. Cylindrical in shape, this receptacle has a diameter of 8 feet, and is about 6 feet deep. The excavation in the ground was at first carefully and regularly made and, when completed, the sides and bottom were covered with a uniform layer of well-kneaded red clay 4 inches in thickness. These clay walls, the interior surface of which was pressed hard and smooth, are still quite perfect. As one looks upon the structure, it presents the appearance of a huge cylindrical terra-cotta vessel let into the earth. There is some indication of the action of fire in hardening the walls. To Briar Creek, and especially to this neighborhood, did the Creek Indians resort to fish and hunt. The adjacent bluffs and fields give token to the present day of former and long-continued occupancy. Village sites may still be seen littered with fragments of earthen vessels, flint chips, spear and arrow points, grooved axes, scrapers, and other objects of primitive manufacture. Even now this stream abounds in fishes, turtles, and alligators, and the swamp, at an early period, was filled with deer, wild turkeys, and other game held in repute by the natives.

Doubtless, during the use of this receptacle, it was furnished with a roof or covering which long since perished. It is probable that in it were stored, from time to time, the fishes caught by visiting Indians. These, having been previously dried, there accumulated until the season arrived for the homeward journey, where they were removed and transported to the permanent lodges of their captors. It is hoped that care will be exercised in the preservation of this interesting object.

SHELL HEAPS AND MOUNDS IN FLORIDA.

By JAMES SHEPARD, *of New Britain, Conn.*

In February, 1884, in company with Dr. F. H. Williams, of Bristol, Conn., I visited Palatka. Many walks about the town were covered with small snail shells which were gathered from large deposits in that vicinity. It was a common belief that these were marine shells; and frequent was the inquiry why the Indians brought these shells from the distant sea. The answer is, "They did not," for the shells are mostly, those of the river snail, *Vivipara contectoides* (Binney). Several of whom I inquired thought that like specimens of live shells could not be found near Palatka. In this opinion they are probably mistaken. On being informed that there was a shell heap on the Saint John's River a few miles below Palatka, four of us started out the next morning to explore the land in that vicinity. Late in the afternoon one of our party discovered a shell heap. It was on low ground, in the woods or hummock, probably not far from the Saint John's River, although the river was not visible. It was literally a heap, quite irregular in form, covering three or four square rods of ground and varying in depth from 2 to 5 feet. It was just such a heap as one would expect a pile of débris to be. There were no indications that any shells had been removed or that the heap had ever been dug into. On the surface the shells were but little broken, and the entire heap appeared to be composed of two kinds of shells, the *Pomus depressa* (Say) and *Vivipara contectoides* (Binney). By digging below the surface, pieces of river mussels or *Unios* were found, very much decomposed and covering the other shells with a nacreous paste. Bones of small animals and birds and flint chips were numerous, with many pieces of pottery and an occasional arrowhead. There were only a few shells in the entire heap of any genera other than the *Pomus*, *Vivipara*, and *Unio.*

On sailing up the Saint John's River we saw several shell heaps on the banks of the river apparently of the same general character, only some of them were much more extensive. We stopped only at Sanford, and there found a shell heap a mile or two below the steamboat landing. This was much larger than the Palatka mound and spread irregularly over the ground. Shells had been carted away from here and the heap dug into in many places by relic hunters. All of the shells were of the same three kinds, *Pomus*, *Vivipara*, and *Unio.* The shells at the surface were very much crushed, indicating that they had been much trodden on. Many pieces of pottery were scattered about over the surface, and others were found by digging. Arrowheads and flint chips were infrequent. In some places indications of ancient fires were found, the shells being burned and firmly cemented together. Below the layer of cemented shells and ashes the shells were found in a remarkable degree of preservation, some of the *Vivipara* showing the four bright brown bands about the body-whorl quite as distinctly as in the day when they were taken from the water. Others seemed to have changed their substance, and were white and glossy with a porcelanous appearance. Here, too, we found a lump of hardened red paint. Some pieces of pottery were perfectly plain, while others were ornamented in various patterns both by scratching and by depressions. Some of the checkered ornamentations seemed to have been made by repeated impressions with a stamp, such as would be produced by making channels in a flat surface at regular distances apart and at right angles to each other, and then, in using the stamp, turning it between each two impressions so as to make the lines in one depression stand obliquely to those of the adjoining one. At the junction of two such depressions the overlapping or intermingled lines were plainly visible. One piece was ornamented by straight parallel depressions, and then, after the depressing implement was withdrawn and while the clay was yet soft, other depressions were made transversely to the first ones, but not so deep, the ribs between the first depressions being flattened down on the cross-lines and partially filling the first depressions. One piece was found of such an arc, that supposing it was from a round vessel the diameter of said vessel was 29 inches.

Near this shell heap were two mounds of symmetrical shape, formed mostly of earth, but partly from shells like those in the heap. The earth was the same as the surrounding soil. These had been dug into considerably, and on digging farther into one of the holes we found the leg and foot bones of a human skeleton, but no implements or ornaments.

In returning we found by a ditch on the flats of the St. John's River, a smaller shell heap of fresh shells, but not thick enough to cover the ground. The shells were identically of the same three kinds. The fresh operculum lying by these shells showed that they had recently been taken alive, and that their meat had been picked out by some small animal. The long-billed curlew (*Numenius longirostris*) is said to eat the live animal from these shells. These shells were of great interest to me for they put at rest all speculation as to where the Indians obtained their supply of food, of which the shell heaps are the refuse, and proved to my mind that they took their shell-fish from the river whose bank they have lined with shell heaps, and also that the same species of mollusks are living there to-day. Undoubtedly this fact has been noted and published before, but there are many who still believe that the shell heaps of the St. John's River are composed of marine shells. When we consider the resemblance of the *Pomus* to the *Natica*, it is not strange that such opinions may be formed by a cursory observer.

Our next stop was at Tampa, Hillsborough County, and our first excursion was to Rocky Point, Old Tampa Bay, about 5 or 6 miles westerly from Tampa, near where the salt works were located during the civil war. Here was a large mound of marine shells situated at the base of the point and extending entirely across it. Oyster shells formed the major part of the pile. Several holes had been dug into the surface which, with the general appearance of the place, indicated that it had frequently been visited. The rocks of which the point is mainly formed and from which the point was named, consists of fossil coral. The material for many of the rough implements found in this vicinity evidently came from this point.

Most of the surface specimens yielded by this heap were found at or near the base of the slanting sides of the pile. In addition to arrowheads, scrapers and rough-shaped implements of quartz, we found pottery and quite a variety of shell and bone implements, the latter being entirely new to us. Among these were several celts quite similar to those illustrated in "The Archæological Collection," p. 67, figs. 254 and 255, also chisels, gouges, pendants, and beads made from the columella of large shells, and smaller chisels made from bone, besides other rough pieces which we suppose were implements of some kind. One piece of pottery was ornamented with impressions of a long spiral shell of the genera *Cerithum*. Near by we found large numbers of live specimens of this shell, some of which quite closely fitted the depressions in this piece of pottery.

On the land of Colonel Culbreath, about 2 miles from Tampa, and on the shore of Old Tampa Bay, is what is termed a "shell hummock." It is cultivated as an orange grove and a market garden. It was probably once an immense shell heap, but now it is scattered over several acres. A little to one side of the center of the lot the ground is slightly elevated and nearly or quite half of the surface material is shell. From this point the shells are less numerous, as they are spread out in all directions, growing gradually less until the soil is free from them. Here we found an abundance of quartz implements and worked pieces of ill-shaped forms, that might or might not have been intended for implements. Others were of fossil coral limestone, like the coral at Rocky Point farther up the bay. Some pieces of the quartz and coral were nearly spherical, the whole (in some cases only a part) of the surface having been formed by chipping. Perhaps, in the absence of natural pebbles in this section, these had been worked out for use as a substitute; perhaps to use as club heads, incased with rawhide. We found rough and somewhat rounded pieces of fossil coral with pit-holes on opposite sides, and a single piece of soapstone, about one and a half inch in diameter by half an inch thick, but its surface was not worked sufficiently to show its use. I refer to it only because it is a material which has not to my knowledge ever been found in nature within several hundred miles of South Florida.

Of shell and bone implements we found all the kinds collected at Rocky Point, celts, gouges, pendants, beads, and also the columella of small conchs, worked into small round shafts pointed at each end. Some of the columella of the larger conchs were worked to a point on one end. There were triangular and other shaped pieces of the shells of the common hard-shell clam worked to a sharp edge on all sides. One spoon was made from the umbo of one of these clam shells, another from the outer whorl of some large conch. We also found beads made from the *Oliva literata*, as illustrated by fig. 260, p. 69, "The Archæological Collection," and large conch shells, perforated and worked to form club heads. Some were minus the hole in posterior surface of the spire, but were otherwise exactly like those described by Dr. Rau on page 66 of said book. A friend of mine has a similar supposed club head from South Florida, consisting of a like conch shell worked in the same manner at the small end and perforated by two holes in the outer wall, but without the notch in the outer lip, so that the handle passed to the right of the columella instead of at the left. The necklace or bead conchs having two holes and truncated at the apex like fig. 257, p. 69, we also found, and it was the first time our attention had ever been called to them. We wondered if they might have been toy club heads for children, but Dr. Rau's book informed us otherwise. In most of these shells the perforations have been so formed that when strung and disposed about a person's neck or chest, the lips and the most brightly colored parts of the shell would be exposed to view. One small disk from a hard clam shell having ragged edges and a beveled perforation in the center was found. The hole was almost identical with those made by boring worms and shells, and one person who saw it was confident that this was only an accidentally broken piece having such a worm-bored hole. Upon having his attention called to the fact that the bevel was at the inner surface of the shell, he was willing to accredit the supposed work of a worm to an Indian. I mention this to show the importance of close observation and how a very little thing may often decide a question. A workman in the field informed us that he often plowed out parts of shells that had been engraved. We visited the hummock several times but found nothing of the kind. At last the workman found one and showed me. It was nothing but a plain unworked columella with the outer whorls broken off undesignedly. He had mistaken the natural spiral lines for carvings. This is about as reliable as the information one can get from those who have never paid special attention to archæological specimens. Fragments of pottery of various patterns were abundant here. The shells were all marine shells excepting such land shells as had probably found their own way to that place.

By Hillsboro' Bay, at the mouth of the Alifia River, several miles below Tampa, is a shell heap called "Bull Frog Mound," so named from the fancied resemblance of its shape to a bull frog when viewed from the water in sailing up the bay. This is by far the most extensive shell heap of any that we visited. It is formed of two mound-shape piles at considerable distance apart, while all the ground between these piles is covered with shells to the depth of several feet. The larger pile is reported to be 60 feet high and stands close to the river; in fact the shells extend well down into the river as if filled in beyond the original bank, so that the mound itself, at this point, now forms the river bank. A large oak tree stands at the very summit of the mound. The lesser pile has been considerably reduced by burning the shells for lime. In front of the mound, looking towards the bay, is a point consisting of a flat salt marsh covered with rushes. The mound is composed largely of oyster shells and appears to have been frequently visited of late. Relics were scarce, and those we did find were of the same class as we had found before. The only relics which could be found here in numbers were the small perforated and truncated conchs for necklaces or beads.

Bordering on the city limits of Tampa, Hillsboro' Bay, and the mouth of Hillsboro' River, is the garrison called "Fort Brooke." Here are two ancient earth mounds which have been dug into considerably, but we could not learn that anything of special value had ever been found. On the ground about the mounds we found bits of pottery, flint chips, a few arrow heads and rough implements. I here found a genuine quartz pebble, about 2 inches in diameter, round and flat, with its edges broken a little on two opposite sides. This was the only specimen of a pebble that I saw in Florida, and I pronounced it a foreigner.

All of the marine shells which we saw at these South Florida shell-heaps corresponded with the live species now inhabiting the waters of that section. All of the stone implements or fragments, except the piece of soap-stone and quartz pebble before noted, corresponded with the limestone, or the lime fossil coral, or the silicified corals, &c., of that region, the latter, so far as I know, being found only in Hillsboro' Bay, and mostly at Ballast Point, about 5 miles below Tampa. In fact all of the arrow heads from South Florida that I have observed appear to have been made of material obtained at or near Ballast Point. Here are many silicified geodes, both large and small, some having an outer surface that shows a coral formation, while the inner surface is of various bright colors of chalcedony or drusy quartz. Here also are pieces of cherty flint of considerable size, which, when they have not been previously broken, are coated with limestone. The beach at low tide is literally covered with quartz that has been artificially broken. Many apparently unfinished implements are found, and also occasionally finished arrow heads, scrapers, &c. Arrow and spear heads were made from the thin flattish sides of geodes, so that the work was much more hazardous than making them from thicker stock. Cavities were numerous even in the best material found here, and presumably for that reason unfinished implements are very numerous in this vicinity. While in many places the beach abounds in stone, I have never known of any having been found, in nature, upon the inland surface.

A little back from the beach at Ballast Point is a long ridge of shells, much broken, as if washed up by the tide. There are, however (the facts before noted), plenty of evidences that this was ground formerly frequented by the Indians, and many believe this ridge of shells to be the remains of an Indian shell heap.

ANCIENT EARTH-WORKS IN CHINA.

By Mark Williams, *of Kalgan, China.*

From Kalgan to Yŭcho are ancient mounds in cluster on the plain or singly on eminences. These latter would indicate signal towers, while the former would suggest tombs. They are about 30 feet high, circular and oval in shape, and no arrangement can be observed in the clusters.

At the base of a signal mound by the great wall of Kalgan I found a stone ax.

The Chinese give no rational explanation of these mounds. I have as yet found no mention of them in ancient records. At Yŭcho, 100 miles south of Kalgan, is a cluster of forty mounds; 4 miles off are ruins of a city wall. Chinese cities have rectangular walls, with towers at short intervals. But this is a circular embankment with no remains of towers. The part of the remaining entrance is unlike the gate of a Chinese city. Records state that this was the seat of a Chinese prince who lived B. C. 200. In some places the wall is levelled, in other places it is perfect, making an acute angle at the summit. Cultivation has narrowed the bases of the mounds, but superstition prevents their destruction. To one familiar with the works of the mound builders in the Mississippi Valley, the stone ax, the mounds, circular wall, suggest a similar race.

PLAN FOR AMERICAN ETHNOLOGICAL INVESTIGATION.

By the late Henry R. Schoolcraft.

[The following programme, though never officially adopted by the Smithsonian Institution, embodies the result of much study of the subject by the distinguished author; and even after the lapse of forty years possesses sufficient interest and suggestiveness to justify its publication.]

"*Plan for the investigation of American ethnology, to include the facts derived from other parts of the globe, and the eventual formation of a museum of antiquities and the peculiar fabrics of nations; and also the collection of a library of the philology of the world, manuscript and printed. Submitted to the Board of Regents of the Smithsonian Institution, at their first meeting, at Washington, in September,* 1846."

New York, *August* 22, 1846.

Gentlemen: In laying before you the following suggestions, I am governed by the opinion that there is a means of investigation of the subject proposed, which possesses general interest as a branch of human knowledge, and cannot but be invested with peculiar force to men of letters dwelling on the western continent. The origin, dispersion, and affinities of nations, and their transference from the eastern to the western hemisphere, prior to the period of Columbus, have constituted subjects of interesting inquiry from the time of the discovery. And viewed in the lights which are now presented by the progress of ethnography, modern geographical discovery, and other means of advancing the study of nations, the inquiry may be supposed to be one which the mind of Mr. Smithson had embraced in his enlarged conception of promoting "the increase and diffusion of knowledge among men."

The occupation of the continent itself by men diverse—in their physical and mental traits and their languages, from the various races of its discoverers at and after 1492; separated as that continent is, by seas and open straits, from other parts of the globe, constitutes an interesting and unsolved problem. And its solution is still more interesting when we reflect that these native races had no maritime skill adequate to the construction of ships; that the state of arts, if we make some local exceptions, was very low; that they were without letters or literature; and, when questioned as to their origin, they put forth traditions which were generally better suited to engage the imagination than to satisfy the judgment.

The extent and noble proportions of the continent, stretching for thousands of miles along the Atlantic, and forming a vast and mountainous barrier between it and the Pacific, entitled it in more than one sense to the appellation it received by every succeeding navigator of the New World. It was indeed a new world, not less in its grand physical structure than for the races of man, who roved over rather than inhabited it. And these latter races, now that 354 years have passed, are quite as much a problem to historians and philosophers, in respect to their early connection and national affinities with the races of Asia, Africa, and Europe, as they were then.

But when we examine this continent in all its sweeping latitudes and longitudes, in its highest altitudes, and in its lowest and broadest valleys, we find imbedded in its very geological strata, as well as in its surface, ruins and other evidences that it had been inhabited long anterior to the Indian race,—that there had been people of diverse arts and habits upon its plains and estuaries. And that, of the red race itself, there are evidences of mutations and changes, reaching from mere sachemships to rude colossal empires, which, like that of Montezuma, broke down, in fact, under the glittering and disproportioned weight of their inherent corruptions and barbarisms.

Forts, mounds, ditches, and works of art, pottery with the triune emblem of the philosophy of Zoroaster, mummies wrapped in their half Nilotic cerements, vast pyramidal structures of earth and of stone, palaces and ruined cities, are among the objects of its antiquarian and historical interest. Not only from the romantic and sublime lake of Titicaca, and the fire-crowned peaks of the valley of Mexico, do we perceive centers of population, rushing out to rule and conquer, but from the yet unexplored plains of the Rio Gila and the Colorado of California, from the broad valley of the Mississippi, from the southern slopes of the Appalachian range of the South Atlantic, and even from the colder latitudes of the Great Lakes, where the indomitable Iroquois built up their republic, we behold a concurring series of facts and discoveries which prove incontestably that various races of the wide-spread and original family of man have lived, and cultivated, and warred, and died at these localities.

When we come to apply to these vestiges of ancient structure the scrutiny of exact observation and description, and to view the facts under the lights of induction and historical analysis, we elicit several classes of evidence which tend to restore important links in the history of the original dispersion of our species, advance us in the scale of knowledge, and go far to enable us to appreciate and understand our position on the globe. And in proportion as this investigation is pressed, in proportion as science is applied to it, and the current of investigation deepened, we abstract from the boundaries of mystery and conjecture, and add to these of ascertained facts and history. We thus progress indeed in knowledge, and compass one of the noblest ends of being.

It is in this light that ethnology makes its appeal to modern letters; and I beg leave to bring its claim to your early consideration. It is proposed to consider ethnology in the most enlarged sense of which the etymology of the word admits as embracing man in his divisions into nations; their affinities and characteristics, mental and physical, with such proofs deduced from history, philology, antiquities, and the exact sciences, as may serve to link nation to nation, and race to race. In this study particular reference is designed to be had to the position of the American continent, and to the aboriginal races found upon it, when first discovered by Europeans. In this view, it will embrace not only geography, antiquities, and history, as descriptive sciences, but likewise the early history of arts, ethnography, comparative philology, geology, and physiology, and such other collateral sciences as may be found necessary to investigate, illustrate, and explain the subject.

The mode of advancing the subject, and carrying into effect the inquiry, so as best to bring out the facts for general information, may admit of some diversity of opinion. It is not an inquiry which admits of extempore results. To consider diligently the various parts of the continent which furnish aliment for the investigation, to scrutinize and collate what has been discovered and written, to collect from mounds and other sources, in various parts of the world, specimens of ancient art, and above all to embody the present and past philology of tribes and nations, is a labor requiring time and attention. Much of this, when acquired, is hardly of a character to sustain popular lectures. It may be doubted, indeed, whether in offering researches in a verbal form they are not always in danger of suffering from the hands of theory and rhetoric. Still, it is a question whether condensed statements of parts of the inquiry may not thus occasionally be thrown out. But whether so or not, the inquiries should be printed at a press owned and controlled by the board, and in a form to correspond with the general style and plan of their publications. In what manner compensations should be awarded, and whether by a temporary appointment or a fixed professorship, having a residence at the parent Institution, and the benefit of its library and collections, in the various departments, may admit of consideration. One remark may however be confidently added, that without adequate provision for the time, books, and travel incident to the inquiry, no person can be expected to enter upon effective labor in this field.

Outlines of the study are sketched in the following synopsis.

(I.) OBJECTS OF INQUIRY.

1. *Physical type of man, or physiological traits by which the several races of men may be distinguished.*

(*a*) *Ethnographical position on the globe.*—Tribes; nations. (*Wiseman.*) Generic groups. (*Blumenbach, Pritchard.*)

2. *Material existence.*

(*a*) *Means of subsistence.*—In the hunter state: (Zea maize, roots and fruits, flesh of animals;) Ichthyophagi: (Coast-tribes, crustaceans, fish. What species?) Herdsmen: (Gens des roche, gens des large.) Agriculturists: (What plants cultivated? how? and by whom? what agricultural tools? Cotton-plant; tobacco; potato.) Concurrent facts in natural history.

(*b*) *Mechanical arts: skill.*—Clothing: skins: bark: hemp-plant; hunting implements; arms; implements of public games; fishing implements: nets: fish-hooks: bone-needles; navigation; vessels: native cordage; utensils for preparing food: knives: pots; potter's art: What condition? vessels of clay—raised by hand or on the wheel? boiling. How effected, where no clay pots? Metallurgy. What facts? Axe of stone, of copper. Trees, how felled? baskets: twine: awls, of bone or horn; pipes of clay, of stone; art of dyeing.

(*c*) *Architecture.*—Dwellings, how made; tools in reference thereto; sculpture; painting; monuments of stone, of earth; temples; roads; bridges; teocalli; mounds; idols; baths; fountains; sepulchres.

(3) *Intellectual existence.*

(*a*) *Languages spoken and written.*

(*b*) *Geographical names.*

(*c*) *Picture writing.*—Hieroglyphics; wampum belts; quippus; inscriptions.

(*d*) *Arithmetic.*—Units: mode and limits of computation; decimal system; vigesimal mode; high numbers, how denoted.

(*e*) *Measure and division of time.*—Day, month, year; astronomical facts; chronology, how denoted; measure of length; capacity; value, (currency.)

(*f*) *Social state and government.*—Civil institutions; political phenomena; laws, penal and civil; marriage; distinctions of rank; castes; clans, chieftainships; descent of titles and rights; totemic principle, how extensive; condition of females; marital rights to property.

(*g*) *Religious belief and institutions.*—Ideas of the Deity; priesthood, how organized; prophets; jossakeeds; metas; nature of worships; fire worship, how spread; demonology; guardian spirits; compensations for *sin;* sacrifices; feasting; fasting; dreams; dancing.

(*h*) *Music and poetry.*—Musical instruments; music boards; mnemonic songs, by symbolic annotation; rhymes, any; war chants; pictorial rolls and devices.

(*i*) *Oral tales and legends.*—Historical fictions; allegories; fables; tales of amusement; concurrent proofs of imagination (*Algic researches*).

(*k*) *Medical knowledge.*—Lancet; cupping; pathology of diseases; magic, as applied to medicine and hunting; botanical remedies; metallic; knowledge of anatomy, what; theory of the circulation of the blood.

(*l*) *Mythology.*—Persian; Egyptian; Chinese; Grecian (*Bryant*); Roman; American.

(*m*) *Philosophy of life, death, and immortality.*—Ancient cosmogony; notions of creation; deluge; monster-era; transformations; metempsychosis; state of the dead; ghosts; witchcraft; idea of vampires.

(4) *Geographical phenomena as affecting or modifying the physical type and the material and intellectual existence.*

Climate; interior or seaboard position; natural productions, as affecting physical development; tropical and torrid zones; influence of the polar latitudes; meteorology and topography generally; effects of snow and ice on the physical type, as in the Eskimo.

(II) MEANS OF ASCERTAINING THE FACTS.

1. *Antiquities and existing monuments.*

(*a*) *Remains of art.*—Buildings; antique excavations; caves; tumuli; pyramids; teocalli; military works, ditches, moats, &c.; columns; arms; the arch, how developed; mechanical tools, of stone, lead, copper; the lever and wedge; idols; sarcophagi; mosaics; bricks, art of making, traced; pottery, how developed; gems and other ornaments; has glass ever been found in American ruins of the ancient period?

(*b*) *Proofs of mental development in the fine arts and composition.*—Laws of proportion in architecture; painting; statuary and sculpture; picture writing; hieroglyphics; phonetic signs; dawning of the alphabet; oral tales and traditionary lore; inscriptions.

2. *Existing intellectual evidences of generic groups.*

(*a*) In vocabularies; (*b*) dictionaries; (*c*) grammars; (*d*) plan of utterance; (*e*) names of places. (Antique.)

3. *Physiology.*

(*a*) Skulls; (*b*) mummies; (*c*) osteological remains.

4. *Historical relations and works.*

(*a*) Works ascribed to natives, as in Mexico; (*b*) works by Europeans; (*c*) missionary translations, &c., modern period; (*d*) authentic traditions of all ages and countries. (Recorded.)

5. *Natural History.*

(*a*) Changes the earth and animated nature have undergone, as denoted by embedded bones; (*b*) what effects have taken place in the superincumbent formations since the existence of mammalia; (*c*) how deep in the geological column can the existence of man be traced; (*d*) general reflex character of geology on the topic.

6. *Mythology, as a proof of mental affiliation in remote and barbarous races.*

In reference to all the objects, it is essential to compare the several American nations one with another, and with the leading nations of other parts of the globe. In proceeding to explore the subject, the first labor must be that of accumulating facts. Visits to the several objects of antiquarian interest demanding attention, with proper instruments for observation, are required. Field surveys of ruins, and drawings of all important objects to be commented on, are essential. Care must be taken to notice whether there be more than one era of occupancy, or one type of nationality, denoted by the same locality. And with the same view the different ages and relative position of the different geological formations, embracing ruins, or objects of art, should be carefully noted. Fossil bones of extinct or ancient species of animals, and beds or banks of shells of the Eocene or Pliocene deposits, furnish the character of evidence denoting separate epochs of occupancy, and become invested with new interest. Traces of organic life of the higher species have been found deeper down in the geological column, in later days, than were known to the elder geologists, and the vestiges of man should be carefully sought in all the unconsolidated strata. We know the globe has been disturbed since its creation and destruction, and we should be prepared to find physical evidences of it. Not only architecture, but metallurgy, pottery, sculpture, and drawing should be interrogated, in examining their remains, on American soil. Inscriptions on rocks are of value, as antiquarian proofs, as well as all traces of the ancient method of symbol or picture writing.

But whatever degree of care is evinced by personal inspection, it is essential to the purposes of comparison that a full and complete collection of antiquarian objects, and the characteristic fabrics of nations, existing and ancient, should be formed and deposited in the Institution. By adding to this, from time to time, such implements of art or war, articles of costume, or other objects of curiosity, as might be obtained, there would be formed, in the end, a museum of mankind, wherein each tribe and nation would be characteristically represented. Such a museum would, in itself, be a desideratum.*

Nothing is more characteristic of the intellectual existence of man than language. It is found to be a more enduring monument of ancient affinities than the physical type, and there is no tribe however situated from whom this proof of affiliation should not be obtained. By collecting a vocabulary and grammar of every known tongue, from printed and verbal sources, the Institution would present to the world a library of philology which would cause its site to be resorted to from the remotest quarters. In the United States and British North America alone we have at least sixty-four dialects and languages.† Nor should the mythology of rude nations be neglected. It is the frame-work of their philosophy and their religion, and gives character to their songs and poetry and every form of intellectual excitement.

Finally, both the duty of observation in the field, and the examination of facts and evidences in the cabinet or library, may be commenced immediately, and need not be delayed until the contemplated buildings are completed, and other parts of the library, &c., perfected. Time is essential in making preliminary examinations. The consideration of the country may be taken up in a separate and systematic manner, taking valley by valley, or State by State. Some portions of the land are more prominent in their claims to notice than others; but in all over which the tide of modern emigration sets, the evidences of its former occupation are rapidly disappearing. The same may be said of the Red Race, whose language and customs it is wished to preserve. The earlier the labor is done, the more easy will be its execution. In the Mississippi Valley alone, where so many evidences of the earliest and heaviest ancient population exist, but a few years will place the most important facts beyond our reach. By adopting the plan suggested, or some plan of this nature, we shall rescue from the oblivion of past generations matter for thought and reflection for the future. As fast as the information is collected, digested, and prepared, it can be submitted to the public. Whatever form for diffusing it the Board may through its committees adopt can be conformed to; and in this way the object may at once be made to assume a practical cast.

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* Many valuable objects of this kind have been brought home by the exploring expedition, and are now deposited in the Patent Office.

† Gallatin, Am. Ant. Col., Vol. 2.

In submitting this plan, which has been hastily sketched, and expressing at the same time the interest he feels personally therein, the undersigned begs leave to subscribe himself,

With high respect, gentlemen, your obedient servant,

HENRY R. SCHOOLCRAFT.

INDEX TO THE LITERATURE OF URANIUM, 1789-1885.

By H. Carrington Bolton.

PREFACE.

> "——Index-learning turns no student pale,
> Yet holds the eel of science by the tail."
>
> *Dunciad*, I, 279.

When engaged in researches on the compounds of uranium, nearly twenty years ago, the writer compiled for his convenience an index to the literature of the element and of its principal compounds. At the suggestion of several friends who thought the compilation ought to be placed at the disposal of chemists, the manuscript was extended and printed in the Annals of the New York Lyceum of Natural History (Vol. IX, Feb., 1870). As published, the index was far from complete; but the simple plan adopted, a chronological arrangement of authorities and references, with brief notes of the subject-matter, seems to have commended itself to chemists, for the Index to the Literature of Uranium was followed by several others similarly arranged. A list of these will be found at the close of this preface.

Impressed by the great importance of index-making, in 1882 the writer proposed to the Chemical Section of the American Association for the Advancement of Science, at the Montreal meeting, the formation of a committee to encourage chemists in a scheme of co-operative indexing briefly outlined at the time. The Chemical Section kindly approved the proposal, and a committee was appointed to "devise and inaugurate a plan for the proper indexing of the literature of the chemical elements." This committee reported in August, 1883, that it had considered three methods of collecting material for the indexes, viz:

1. Reviewing the Catalogue of Scientific Papers published by the Royal Society. (8 vols. 4to.)

2. Indexing special journals by different individuals and collating the matter.

3. The independent plan, whereby each chemist indexes all the journals accessible to him with reference to a given element, in which he is presumably especially interested.

Each of these schemes is open to objections and fraught with difficulties that need not be named. On the whole, the third plan seemed to a majority of the committee the only feasible one for the present. The report also considers the best arrangement of material, and three ways are suggested: (1) chronologically; (2) alphabetically by authors; (3) topically. The committee do not venture to dictate to volunteer and independent workers, but recommend the chronological arrangement, accompanied by a topical index.

In September, 1884, the committee further reported that several indexes had been published during the twelve months intervening, and that more were in progress. They also announced that the Smithsonian Institution had consented to publish indexes to chemical literature indorsed by the committee, limiting somewhat the number of pages per annum. The Smithsonian Institution also distributes, free of expense, the circulars and publications of the committee.

The following work is offered as an additional contribution to the series of indexes named below. It is, strictly speaking, a second edition of that published in 1870, but much new matter has been added and new features introduced, so that in reality it forms an entirely new work. The edition of 1870 contains 522 references to papers by 150 authors; the present index contains 1,330 references to papers by more than 300 authorities. New matter has been incorporated with that of the first edition, and the whole has been brought down to the close of 1885, covering a period of sixteen years of much activity. In each paragraph the first reference following the name of an author is that of the original publication of the paper in question; the succeeding references are those of reprints or abstracts of the original.

In accordance with the suggestion of the index committee, two indexes have been added—an alphabetical index of authors and a classified index of subjects. These, it is believed, will materially increase the utility of the work. The scheme of classification adopted for the subject index is by no means an ideal one. It is not intended to serve as a model for others, but it is deemed the most satisfactory attainable with the material in hand. Knowing, moreover, that as a rule classification schemes are intelligible only to their authors, we have added a synopsis of the classification to serve as a key. In using the author and subject indexes, it must be remembered that they refer to the items in the chronological index, and that the contents of each paper are not completely indexed. Finally, the list of abbreviations will remove doubts as to the journals quoted, and will show at the same time what sets have been thoroughly examined.

H. CARRINGTON BOLTON,
Chairman of Committee on Indexing Chemical Literature.

LIST OF INDEXES TO CHEMICAL LITERATURE.

Uranium, Index to the literature of. By H. Carrington Bolton. Annals of the New York Lyceum of Natural History; Vol. IX, February, 1870. 15 pp. 8vo.

Manganese, Index to the literature of; 1596–1874. By H. Carrington Bolton. Annals of the Lyceum of Natural History, New York, Vol. XI, November, 1875. 44 pp. 8vo.

Titanium, Index to the literature of; 1783–1876. By Edw. J. Hallock. Annals of the N. Y. Academy of Sciences, Vol. I., Nos. 2 and 3, 1877. 22 pp. 8vo.

Vanadium, Index to the literature of. By G. Jewett Rockwell. Annals of the N. Y. Academy of Sciences, Vol. I, No. 5, 1877. 13 pp. 8vo.

Ozone, Index to the literature of; 1875–'79. By Albert R. Leeds. Annals of the N. Y. Academy of Sciences, Vol. I, No. 12, 1880. 32 pp. 8vo.

Peroxide of hydrogen, The literature of; 1818–'78. By Albert R. Leeds. Annals of the N. Y. Academy of Sciences, Vol. I, No. 13, 1880. 11 pp. 8vo.

Electrolysis, Index to the literature of; 1784–'80. By W. Walter Webb. Annals of the N. Y. Academy of Sciences, Vol. II, No. 10, 1882. 40 pp. 8vo.

Speed of chemical reactions, Literature of. By Robert B. Warder. Proceedings of the Am. Assoc. Adv. Science, Vol. 32, 1883. 3 pp. 8vo.

Starch-sugar, Bibliography of. By Edw. J. Hallock. Appendix E to report on glucose, prepared by the National Academy of Sciences in response to a request made by the Commissioner of Internal Revenue. U. S. Internal Revenue, Washington, D. C., 1884. 44 pp. 8vo.

Ozone, Index to the literature of (1879–'83); accompanied by a historical-critical résumé of the progress of discovery since 1879. By Albert R. Leeds. Annals of the N. Y. Academy of Sciences, Vol. III, p. 137, 1884. 16 pp. 8vo.

Peroxide of hydrogen, Index to the literature of; 1879–'83. By Albert R. Leeds. Annals of the N. Y. Academy of Sciences, Vol. III, p. 153, 1884. 3 pp. 8vo.

Dictionary of the action of heat upon certain metallic salts, including an Index to the principal literature upon the subject. Compiled and arranged by J. W. Baird; contributed by A. B. Prescott. New York, 1884. 70 pp. 8vo.

Catalogue of chemical periodicals. By H. Carrington Bolton. Annals of the N. Y. Academy of Sciences, Vol. III, p. 159, 1885. 58 pp. 8vo.

Committee on indexing chemical literature.

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INDEX TO THE LITERATURE OF URANIUM, 1789–1885.

Date.	Author.	Remarks.	References.
1789	Klaproth	Discovery of element	Schriften berl. Ges. naturf. Fr., IX, 373; Mém. acad. roy. sci., Berlin, 1786–87, 160; Crell's Ann., 1789, II, 387; Ann. ch. phys. [1], IV, 162; Klapr. Beiträge, II, 197; Klapr. Analytical Essays, London, 1801, 476.
1789	Karsten		Schriften berl. Ges. naturf. Fr., IX, 170.
1789	La Méthérie		Journ. de phys., 1789, 399.
1789	Crell		Journ. de phys., XXXV, 391.
1790	Hecht		Journ. de phys., XXXVI, 53.
1790	Klaproth	Nitrate	Crell's Ann., 1790, I, 291.
1792	Hermbstädt	Researches and metal (oxide).	Crell's Ann., 1792, II, 311.
1793	Klaproth	Correction	Ann. chim. phys. [1], VI, 175; Crell's Ann. 1793, II, 151.
1793	Fuchs, G. F. C	Metal (oxide)	Acta acad. moguntinæ, 1793; Ueber Richter's Darst. d. Urans, Erfurt, 1793.
(?)	Champeaux	Occurrence in France.	Bull. soc. philomath., Paris, VIII, 107.
1795	Saussure	Blowpipe reactions	Crell's Ann., 1795, I, 210.
1797	Kirwan	Methods of decomposing minerals.	Crell's Ann., 1797, II, 503.
1798	Tychsen		Trommsd. J. der Pharm., V, 121.
1799	A. B	Note	Phil. Mag., 1799, 112.
1800	Ritter	Magnetic properties	Gilbert Ann., IV, 24.
1803	Proust	"Silène"	Gilbert Ann., VII, 127.
1805	Richter	Researches	N. Gegenst. der Ch., I, 1; IX, 36; Gehlen's J., IV, 402.
1805	Bucholz	Researches	Gehlen's J., IV, 17 and 134; Ann. ch. phys. [1], LVI, 142; Repert. Arts [2], VIII, 274; Bucholz Beiträge, I, 62.
1807	Thomson	Occurrence in sand from river Dee.	Trans. Roy. Soc. Edinb., 1807; Phil. Mag., 1810, 98.
1810	Vauquelin	Method of decomposing uraninite.	Ann. chim. phys. [1], LXVIII, 277; Nicholson's J., XXV, 69.
1811	John	Chromate	Schweigg. J., II, 382.
1813	Schönberg	Estim. of atomic weight	Schweigg. J, XV, 284; Dissert. de conjunct. chem. ejusque ration. Upsala, 1813, 18.
1814	Porrett	Sulphocyanide	Phil. Trans., 1814, 553.
1817	Chevreul	Carbonate of U and K	J. de phys., LXXXV, 472; Ann. Phil., XII, 31.
1818	Chevreul	Acidity of peroxide	Bull. des sci., 1819, 20; Ann. Phil., XII, 144.
1818	Berzelius	Selenate	Schweigg. J., XXIII, 457.
1819	Clarke, E. D	Reduction of U. oxide	Gilbert Ann., LXII, 353.
1820	Gahn	Blowpipe reactions	Schweigg. J., XXIX, 307.
1821	Brandes	Suberate	Schweigg. J., XXXIII, 100.
1822	Arfvedson	Researches	Kong. Vet. Acad. Handl., 1822, 404; Pogg. Ann., 1, 245; Schweigg. J., XLIV, 8; Ann. ch. phys. [2], XXIX, 148; Ann. Phil., N. S., VII, 253; Am. J. Sci., VII, 185; Edinb. Phil. J., X, 369; Ann. d. M., X, 130; Berz. Jahresb., II, 120.
1823	Berzelius	Fluoride	Kong. Vet. Acad. Handl., 1823, St. II; Ann. Phil., XXIV, 337.
1823	Brande	Extraction	Quart. J. Sci., XIV, 86; Schweigg. J., XLIV, 1.
1823	Lecanu & Serbat	Extraction	J. de pharm., IX, 141 and XI, 279; Schweigg. J., XLIV, 35.
1823	Laugier	Examination of autunite	J. de pharm., IX, 145, XI, 286; Schweigg. J., XLIV, 40; Ann. ch. phys. [2], XXIV, 239.
1823	H. Rose	Sulphide	Gilb. Ann., LXXIII, 139.
1823	Berzelius	Researches and minerals	Kong. Vet. Acad. Handl., 1823, 155; Pogg. Ann., I, 359; Ann. d. M. [1], X, 137 and 299; Schweigg. J., XLIV, 191; Berz. Jahresb., IV, 117; Ann. Phil., XXV, 266.
1824	Berzelius	U soluble in aq	Pogg. Ann., II, 149.
1825	Berthier	Oxide	Ann. d. M. [1], X, 141.
1825	Gmelin	Physiological action of salts.	Schweigg J., XLIII, 110; Edinb. Med. and Surg. J., XXVI, 136.
1825	Pleischl	Iodate	Schweigg., XLV, 23.
1826	Berzelius	Sulph-arsenate	Pogg. Ann., VII, 28 and 148.
1826	Berzelius	Sulphocarbonate	Pogg. Ann., VI, 456.
1826	Berzelius	Sulphomolybdate	Pogg. Ann., VII, 276.
1827	Fischer	Reduct. by metals	Pogg. Ann., IX, 264; J. pr. Ch., XXIV, 227
1829	Fischer	Reduct. by metals	Pogg. Ann., XVI, 125.

Index to the literature of Uranium, 1789-1885—Continued.

Date.	Author.	Remarks.	References.
1829	Quesneville	Extraction	J. de pharm., XV, 493; Dingl. pol. J., XXXIV, 143; Berz. Jahresb., X, 117; Schweigg. J., LVII, 127.
1830	Berthemot	Bromide	Ann. ch. phys. [2], XLIV, 387.
1830	Stromeyer	Pyrophosphate	Gött. gelehrt. Anz., 1830, I, 111; Schweigg. J., LVIII, 130.
1831	Davis	Use as mordant	Repert. Pat. Inv., March, 1831, 174; Dingl. pol. J., XL, 152.
1831	Berzelius	Vanadate	Pogg. Ann., XXII, 63.
1832	Herschel	Separation from iron by K_2FeCy_3.	Ann. ch. phys., XLIX, 310; Pogg. Ann., XXV, 627; Berz. Jahresb., XIII, 120.
1834	Berzelius	Tellurate	Pogg. Ann., XXXII, 596 and 608.
1834	Persoz	Separation by acetate lead	Ann. ch. phys. [2], LVI, 333; J. pr. Ch., 1834, III, 216; Instit., No. 70, 299; Berz. Jahresb., XV, 195; Pogg. Ann., XXXIII, 248.
1835	Persoz	Separation by CuO and HgO.	Ann. ch. phys. [2], LVIII, 202.
1835	Berzelius	Pyroracemate	Pogg. Ann., XXXVI, 24.
1837	Heller	Croconate and rhodizonate	J. pr. Ch., XII, 228 and 239.
1837	Marchand	Sulphethylate	J. pr. Ch., XII, 264; Pogg. Ann., XLI, 629.
1838	Werner	Extraction	Ann. Ch. Pharm., XXVIII, 240; J. pr. Ch., XII, 381; Dingl. pol. J., LXVIII, 465.
1841	Regnault	Specific heat of metal (oxide).	Ann. Ch. Pharm., XXXVI, 108; Berz. Jahresb., XXI, 13.
1841	Plantamour	Attempt to reduce protoxide.	J. pr. Ch., XXIII, 230; Pharm. Centr., 1841, 592.
1841	Rammelsberg	Sulphantimoniate	Ann. Ch. Pharm., XL, 286.
1841	Marchand	Atomic weight	J. pr. Ch., XXIII, 497.
1841	Wöhler	Vd. in Uranpecherz	Pogg. Ann., LIV, 600.
1841 to 1842	Péligot	Metallic U and general researches.	C. R., XII, 735; J. pr. Ch., XXIII, 494; XXIV, 442; J. de pharm., XXVII, 525; Ann. ch. phys. [3], V, 1; Ann. Ch. Pharm., XLI, 141.
1841 to 1842	Péligot	Metallic U and general researches.	Ann. Ch. Pharm., XLIII, 255; Pharm. Centr., 1842, 321 and 847; Berz. Jahresb., XXII, 113; XXIII; Pogg. Ann., LIV, 122.
1842	Ebelmen	Researches. Action of light; oxalate, sulphate.	Ann. Ch. Pharm., XLIII, 286; Ann. ch. phys. [3], V, 189; Pharm. Centr., 1842, 863; J. pr. Ch., XXVII, 385; Berz. Jahresb., XXIII.
1842	Wittstein	Extraction	Buchner's Repert., LXIII, 231.
1842	Delffs	Carbonate, &c	Pogg. Ann., LV, 229; Berz. Jahresb., XXIII, 201.
1842	Wöhler	Preparation of cryst. UO_2	Ann. Ch. Pharm., XLI, 345; Berz. Jahresb., XXIII; Journ. de Pharm. [3], II, 43.
1842	Kühn	Criticism on Péligot	Ann. Ch. Pharm., XLI, 337; Pharm. Centr., 1842, 324.
1842	Fresenius	Cyanide	Ann. Ch. Pharm., XLIII, 135.
1842	Wertheim	Acetates	Monatsb. d. berl. Akad., 1842; J. pr. Ch., XXIX, 209; Ann Ch. Pharm., XLIV, 274; Ann. ch. phys. [3], XI, 49; Annuaire chim., 1845, 118; Pharm. Centr., 1843, 585; Pogg. Ann., LVII, 481.
1842	De la Provostaye	Crystallographic	Ann. ch. phys., V, 47; VI, 165; Berz. Jahresb., XXIII, 213.
1843	Rammelsberg	Bromate	J. pr. Ch., XXIV, 285; Berz. Jahresb., XXII, 140.
1843	Berthier	Sulphite and separation	Ann. Ch. Pharm., XLVI, 184; Pharm. Centr., 1843, 382.
1843	Bonaparte	Valerianate; action of light	J. pr. Ch., XXX, 308; Pharm. Centr., 1843, 949.
1843	Köhnke	Technical uses	Wiener polyt. J., 1843, 1117.
1843	Malaguti	Hydrated sesquioxide	Ann. Ch. Pharm., XLVIII, 236; Ann. ch. phys., IX, 463; Annuaire chim., 1845, 118; J. pr. Ch., XXIX, 231; C. R., XVI, 851; Pharm. Centr., 1843, 590; Berz. Jahresb., XXIV, 118.
1843	Cock	Artificial Uranite	Proc. Chem. Soc. Lond., I, 38.
1844	Rammelsberg	Uranous salts	Ann Ch. Pharm., XLVIII, 234; Pogg. Ann., LV, 318; LVI, 125; LIX, 10; Berz. Jahresb., XXIII.
1844	Rammelsberg	Atomic weight	Pogg. Ann., LIX, 1; J. pr. Ch., XXIX, 234; Berz. Jahresb., XXIV, 117; Pharm. Centr., 1843, 577.
1844	Bottinger	Separation	Ann. Ch. Pharm., LI, 407; Pharm. Centr., 1845, 107.
1844	Muspratt	Sulphites	Ann. Ch. Pharm., LV, 290.
1845	Péligot	Tartrates, &c	C. R., XVIII, 682; Annuaire chim., 1845, 117; Ann. ch. phys., XII, 549; Ann. Ch. Pharm., LVI, 230; Pharm. Centr., 1845, 193.

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1845	Playfair and Joule	Spr. gr. and at. vol. of oxides.	Mem. Chem. Soc. Lond., III, 83.
1845	Wöhler	Purification from Co Ni and Zn.	Ann. Ch. Pharm., LVI, 127; Annuaire chim., 1847, 94.
1846	Berzelius		Berz. Jahresb., XXV, 162.
1846	Peters	Extraction	Arch. der Pharm., XLVII, 146; Pharm. Centr., 1846, 831.
1847	Arppe	Pyrotartrate	Inaug. Diss., Helsingf., 1847; Ann. Ch. Pharm., LXVI, 73.
1847	Engelherdt and Maddrell.	Lactate	Ann. Ch. Pharm., LXIII, 99.
1847	Persoz	Pyrophosphate	Ann. chim. phys. [3], LXV, 165; Jahresb., 1847-48, 353.
1847	Péligot	Atomic weight	C. R., XXII, 487; Ann. Ch. Pharm., LX, 183, Ann. ch. phys. [3], XX, 329; J. pr Ch.; XLI, 398; and XXXVIII, 152; Jahresb., 1848, 418; Journ. de pharm [3], X, 80.
1848	Werther	Phosphates and arsenates.	J. pr. Ch., XLIII, 321; XLIV, 127; Ann. Ch, Pharm., LXVIII, 312; Pharm. Centr., 1848. 433; Instit., 1848, 393; J. de pharm. [3], XIV, 57; Annuaire chim., 1848, 140 and 144; Phil. Mag. [3], XXXIII, 244; Jahresb., 1849, 418 and 1218.
1849	Patera	Extraction on large scale	Wien. Acad. Ber., 1849, 353; Wien. Ber. Freund. d. Wiss., IV; J. pr. Ch., XLVI, 182; Jahresb., 1849, 274, 584.
1849	Leconte	Estimation of phosphoric acid.	C. R., XXIX, 55; Jahresb., 1849, 572.
1850	Patera	Red sulphide	J. pr. Ch., LI, 122; Ann. Ch. Pharm., LXXXVI, 254; Pharm. Centr., 1851, 402; Jahresb., 1850, 313; Annuaire chim., 1851, 118.
1850	Muspratt	Selenites	J. Chem. Soc., II, 68.
1852	Stokes	Fluorescence of uranium glass.	Phil. Mag. [4], IV, 388; Pogg. Ann., LXXXVII, 488; Am. J. Sci. [2], XV, 270; Jahresb., 1853, 140; Ann. chim. phys. [3], XXXVIII, 505.
1852	Giesecke	Extraction	Arch. Pharm. [2], LXIX, 150; J. pr. Ch., LV, 445; Dingl. pol. J., CXXIV, 355; Pharm. Centr., 1852, 232; Jahresb., 1852, 779.
1852	Stokes	Detection by absorption spectrum.	Instit., 1852, 392; Jahresb., 1854, 125.
1852	Girard	Sulphite	C. R., XXXIV, 22; Ann. Ch. Pharm., LXXXI, 366; Pharm. Centr., 1852, 100; J. pr. Ch., LV, 285; J. de pharm. [3], XXI, 183; Jahresb., 1852, 376.
1852	Schabus	Crystallographic forms of acetate.	Jahresb., 1852, 433.
1853	Patera	Extraction on large scale	Wien. Acad. Ber., XI, 842; J. pr. Ch., LXI, 397; Pharm. Centr., 1854, 236; Dingl. pol. J., CXXXII, 36; Chem. Gaz., 1854, 178; Jahresb., 1853, 740.
1855	Werther	Fluorescence	J. pr. Ch., LXV, 349; Pharm. Centr., 1855, 605; Phil. Mag. [4], X, 390; Jahresb., 1855, 132.
1855	Marbach	Optical examination	Pogg. Ann., XCIV, 422; Ann. chim. phys. [3], XLIV, 45.
1855	Williams, C. Gr.	Oxychloride and organic bases.	Chem. Gaz., 1855, 450; C. C., 1856, 47; Trans. Roy. Soc. Edinb.; Jahresb., 1855.
1856	Williams, C. Gr.	Oxychloride of U and chinoline.	Trans. Roy. Soc. Edinb., XXI, part III, 377; Chem. Gaz., 1856, 261, 283; J. pr. Chem. LXIX, 355; C. C., 1856, 817; Jahresb., 1856, 532.
1856	Graham	Dialysis of nitrate	J. Chem. Soc., VIII, 91.
1856	Patera	Purification of U yellow	Ding pol. J., CXLI, 372; C. C., 1856, 843; Polyt Centr., 1857, 75; J. pr. Ch., LXIX, 118; Oestr. Zeits. Berg u. Hütt., 1856, 31.
1856	Knop	Estimation	J. pr. Ch., LXIX, 401; C. C., 1856, 738 and 803; Jahresb., 1856, 728.
1856	Scheibler	Acetate of U and Li	C. C., 1856, 717; J. pr. Chem., LXVII, 485; Jahresb., 1856, 331.
1856	Keferstein	Crystallographic form of carbonate.	Pogg. Ann., XCIX, 275; Jahresb., 1856, 380; J. pr. Chem., LXIX, 303.
1856	Péligot	Preparation of metallic U.	C. R., XLII, 73; Instit., 1856, 29; J. de pharm. [3], XXIX, 203; Ann. Ch. Pharm., XCVII, 256; Pogg. Ann., XCVII, 630; J. pr. Ch., LXVIII, 184; C. C., 1856, 223; Jahresb., 1856, 380; Phil. Mag., 1857, 123.

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1857	Kessler	Extraction from uraninite.	J. de pharm. [3], XXXI, 182; C. R., XLVI, 530; Dingl. pol. J., CXLIX, 77; C. C., 1858, 336; Polyt. Cent., 1858, 1513; Jahresb., 1857, 199; Verh. d. Niederöstr. Gewerbevereins, 1858, 293.
1857	Burnett	Photographic prints	Liverpool Phot. J., 1857 and 1858; Humphrey's J., 1857, 81; 1858, 44.
1857	Arendt and Knop	Extraction	C. C., 1857, 162; J. pr. Ch., LXXI, 68; Jahresb., 1857, 200.
1858	Ordway	Basic salts	Am. J. Sci. [2], XXVI, 197; J. pr. Chem., LXXVI, 19; Jahresb., 1858, 115.
1858	Weselsky	Acetates	Wien. Acad. Ber., XXX, 205; Chem. Gaz., 1858, 390; J. pr. Ch., LXXV, 55; C. C., 1858, 610; Jahresb., 1858, 282.
1858	Brianchon	Technical uses	Génie Indust., 1858, 147; Technologiste, 1858, 521; Polyt. Centr., 1858, 1242; Dingl. pol. J., CXLVIII, 172; C. C., 1858, 698; Polyt. Centralhalle, 1858, 670.
1858	Spiller	Influence of citric acid	J. Chem. Soc., X, 114.
1858	Crespon & Godefroy	Photography	Polyt. Centr., 1858, 1509; Humphrey's J., 1858, 172.
1858	Hagen	Photographic printing	Ber. Akad. Wiss. Berl., 1858, 290; Brit. J. Phot., V, 75; Humphrey's J., 1858, 262; J. pr. Ch., LXXIV, 67; Dingl. pol. J., CXLIX, 437; C. C., 1858, 764; Instit., 1858, 268.
1858	Grailich	Cryst. and Opt. studies	Wien. Acad. Ber., XXVII, 3.
1858	Verdet	Magnetic rotary power	Ann. chim. phys. [3], LII, 158.
1858	Niepce de St. Victor	Absorption of light and use in photography.	C. R., XLVI, 449; Instit., 1858, 73; Dingl. pol. J., CXLVIII, 126; J. pr. Ch., LXXIV, 233, Cimento, VII, 202; Jahresb., 1858, 18.
1858	Niepce de St. Victor	Absorption of light and use in photography.	C. R., XLVII, 866 and 1002; Instit., 1858, 398 and 427; Humphrey's J., 1858, 10; Dingl. pol. J., CLI, 130 and 435; Jahresb., 1858, 20.
1859	Niepce de St. Victor	Absorption of light and use in photography.	C. R., XLIX, 815; Dingl. pol. J., CLV, 456; Jahresb., 1859, 33; Cosmos, XIV, 568; Polyt. Centr., 1859, 889 and 1032.
1859	Becquerel	Phosphorescence	Ann. chim. phys. [3], LV, 86, and LVII, 101.
1859	Uhrlaub	Nitride	Verbind. einiger Met. mit Stickstoff, Göttingen, 1859, 27.
1859	Hallwachs and Schafarik.	Action of U on iodide ethyle.	Ber. Acad. Wiss. Wien, XXXIII, 569; Pharm. Centr., 1859, 163.
1859	Pincus	Estimation of phosphoric acid with acetate of U.	J. pr. Ch., LXXVI, 104; Jahresb., 1869, 667.
1859	Wysocky	Extraction on large scale.	Oest. Zeitschr. Berg- u. Hüttenw., 1859; Dingl. pol. J., CLV, 305; C. C., 1860, 327; Polyt. Centr., 1860, 139; Jahresb., 1860, 698.
1859	N. de St. Victor and Corvisart.	Action of light on oxalate.	C. R., XLIX, 368; Instit., 1859, 287; Ann. Ch. Pharm., CXIII, 112; Dingl. pol. J., CLVI., 38; Jahresb., 1859, 33.
1859	Corvisart	Action of light	Bull. soc. chim., 1862, 62; Jahresb., 1859, 33.
1860	Rose	Estimation	Pogg. Ann., CX, 141.
1860	De Luynes	Photographic printing.	Brit. Photogr. J., 1860; Polyt. Centr., 1860.
1860	Burnett	Actinometry	Phil. Mag. [4], XX, 50 and 406.
1860	Wothly	Original announcement	Horn's Photog. J., XVI, 104.
1860	Wothly	U with PtCl of Wothly's process.	Polyt. Centr., 1860.
1860	Sutton	Estimation of phos. acid	Chem. News, I., 97, 192; Jahresb., 1860, 622.
1860	Anthon	Extraction	Dingl. pol. J., CLVI, 207 and 288; Zeitschr. Ch. Pharm., 1860, 412; Rép. chim. appl., II., 281; C. C., 1860, 549 and 591; Polyt. Centr., 1860, 1118, and 1274.
1861	Drenkmann	Historical summary and researches.	Zeitschr. ges. Naturw., XVII, 113; Jahresb., 1861, 255.
1861	Becquerel	Phosphorescence	Ann. chim. phys. [3], LXII, 42.
1861	Hermann, H	Researches	Inaug. Dissert. Gött., 1861; Jahresb., 1861, 258.
1861	Fresenius	Estimation	J. pr. Ch., LXXXII, 257; Chem. News, 1861, 150.
1861	Graham	Saccharate	J, Chem. Soc. XV, 254; Ann. Ch. Pharm., CXXI, 52; Jahresb., 1861, 77.
1861	Schrauf	Optical examination of acetate.	Pogg. Ann., CXII, 593.
1861	Pisani	Estimation and mineral analyses.	C. R., LII, 72 and 817; Rép. chim. pur., III, 222 and 639; Zeitschr. Ch. Pharm., 1861, 123; J. pr. Ch., LXXXV, 186; C. C., 1861, 221; Chem. News, III, 211; Jahresb., 1861, 824 and 1030.

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1861	Debray	Artificial crystallized phosphates.	Ann. chim. phys. [3], LXI, 445.
1862	Vogelsang	Technical	Preuss. Zeitschr. Berg-, H. u. Salin., X, 168.
1862	Burghess	Toning bath	Polyt. Centr., 1862, 1590; Am. J. Photog., 1862.
1862	Simpson	Action of light	Am. J. Photog., VII, 295.
1862	Draper	Action of light	Brit. J. Photog., II. 241.
1862	Maack	Action of Al and Mg on solution	Verhalt. des Mg. und Al. zu Salzlösungen, Göttingen, 1862, 32.
1862	Rose, H	Estimation	Pogg. Ann., CXVI, 352; CX, 141; Zeitschr. anal. Ch., I, 411; Rép. chim. pur., V, 27; Chem. News, VII, 159 and 99; C. C., 1862, 863; Jahresb., 1862, 601.
1862	Brachet	Use of U glass	C. R., LV, 409.
1862	Parkmann	Carbonate	Am. J. Sci. [2], XXXIV, 321; Chem. News, 1863, 122; C. C., 1863, 465.
1863	Guyard	Volumetric estimation	Bull. soc. chim., 1864, I, 94; Jahresb., 1863, 692; Chem. News, 1864, 13; Zeitschr. anal. Ch., III, 376.
1864	Phipson	Action of Mg on solutions	Proc. Roy. Soc. Lond., XIII, 217; Jahresb., 1864, 193.
1864	Stolba	Estimation, silico-fluoride	Zeitschr. anal. Ch., III, 71; C. C., 1864, 1053; Jahresb., 1864, 718.
1864	Grothe	Action of alkalies, &c.	J. pr. Chem., XCII, 177.
1864	Hoyermann	Estimation of phosphoric acid.	Arch. Pharm. [2], XCIX, 193; Jahresb., 1864, 691.
1864	Remelé	Oxysulphide	C. R., LVIII, 716; Bull. soc. chim. [2], I, 36; N. Arch. ph. nat., XX, 52; Ann. Ch. Pharm. Suppl., III, 196; Pogg. Ann., CXXIV, 114; J. pr. Ch., XCIII, 316; C. C., 1864, 596; Chem. News, X, 123 and 158; Jahresb., 1864, 234.
1864	Liesegang	Action of light on ammonio citrate, and photography.	Monit. photogr. 1864, No. 17, Nov. 25; Bull. soc. chim. II. 482; Chem. News, 1865, 103; C. C., 1865, 1151.
1865	Von Hauer	Acetate	Pogg. Ann., CXXV, 149; C. C., 1865, 735.
1865	Knop	Estimation	C. C., 1865, 161; Jahresb., 1865, 223.
1865	Remelé	Estimation and separation; oxysulphide.	Pogg. Ann., CXXV, 209; Zeitschr. anal. Ch., IV, 371; Zeitschr. Ch., 1865, 548; 1866, 471; J. pr. Ch., XCVII, 193 and 280; Bull. soc. chim., VI, 318; C. C., 1866, 628; Jahresb., 1865, 221 and 726.
1865	Gibbs	Separation	Am. J. Sci. [2], XXXIX, 58; C. C., 1865, 407; J. pr. Chem., XCV, 357; Zeitschr. anal. Chem. III, 327; Zeitschr. Chem., 1865, 307; Dingl. pol. J., CIXXVIII, 133; Chem News, XI, 101, *et seq.;* Jahresb., 1865, 727.
1865	Remelé	Sulphite	Pogg. Ann. CXXV, 238; Jahresb., 1865, 225; J. pr. Chem., XCVII, 214.
1865	Seekamp	Action of light on the succinate.	Ann. Ch, Pharm., CXXXIII, 253; Zeitschr. Chem., 1865, 317; C. C., 1865, 767; J. pr. Chem., XCVI, 192; Bull. soc. chim. [2], IV, 132; J. de pharm. [4], II, 67; Phil. Mag. [4]. XXX, 358; Jahresb., 1865, 389,
1865	Tunny	Photography	Humphreys, J., Jan., 1865, Bull. soc. chim., III, 320.
1865	Wothly	Wothly type	Bull. belge photog., 1864; Am. J. Photog., VII, 1865.
1865	Wothly	Specification of patent	Polyt. Centr., 1865, 943; Photog. Archives, 1865.
1865	Liesegang	Photography	Monit. photogr. Jan. 1, 1865; Bull. soc. chim. III, 159.
1866	Elsner	Volatility of UO_3	Chem. techn. Mittheil, 1857-'58, 36; Jahresb., 1866, 35; J, pr. Chem., XCIX, 260.
1866	Bunsen	Flame reactions	Ann. Ch. Pharm. CXXXVIII, 291; Zeitschr, anal. Chem. V, 377; Phil. Mag. [4], XXXII, 81; N. Arch. ph. nat. XXVII., 25; Jahresb., 1866, 783.
1866	Commaille	Action of Mg on solutions.	Bull. soc. chim. [2], VI, 257, Jahresb., 1866, 171
1866	Wysocky	Manufacture of U yellow.	Oestr. Zeit. Berg- u. Hüttw., 1866; Polyt. Centr., 1868, 1601; Dingl. pol. J., CLXXXI, 448; Jahresb. chem. Tech., 1866. 275; Bull. soc. chim. [2], VI, 494; Jahresb., 1866, 840.
1866	Belohoubek	Volumetric estimation	J. pr. Ch., XCIX, 231; Zeitschr. anal. Ch., VI, 120; Zeitschr. Ch., 1867, 121; C. C. 1867, 656; Bull. soc. chim. [2], VII, 494; Jahresb., 1866, 809.

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1866	Patera	Estimation of U in ores	Dingl. pol. J., CLXXX, 242; Zeitschr. anal. Ch., V, 228; Bull. soc. chim. [2], V, 442; Jahresb. chem. Tech., 1866, 274; Les Mondes, 1866, 234; Dingl. pol. J., CLXXX, 242; Polyt. Notizbl., 1866, 222; Deutsche Industrie Ztg., 1866, 208; Chem. News, XIII, 291; Polyt. Centr., 1866, 831; Jahresb., 1866, 809.
1866	Frisch	Tartrate	J. pr. Chem. XCVII, 281; Zeitschr. Chem., 1866, 345; C. C., 1866, 598; Bull. soc. chim. [2], VII, 257; Jahresb, 1866, 401.
1866	Bolton	Fluorides, oxyfluorides; action of light.	Berl. Akad. Ber., 1866, 299; Inaug. Diss., Göttingen, 1866; Bull. soc. chim. [2], VI, 450; Zeitschr. Ch. [2], II, 353; J, pr. Ch. XCIX, 269; C. C, 1866, 977; N. Arch. ph. nat., XXVI, 338; Jahresb., 1866, 209.
1867	Skey	Sulphocyanide	Chem. News, XVI, 201; Zeitschr. Chem. [2], IV, 123.
1867	Souchay	Composition of the hydrated ammoniacal carbonate.	Zeitschr. Chem. [2], IV, 527; Zeitschr. anal. Chem., VI, 400; Bull. soc. chim., X, 375.
1867	Graham	Soluble modification of oxide.	Ann. Ch. Pharm. CXXI, 52, Jahresb., 1867, . 77.
1867	Scheller	Sulphites	Ann. Ch. Pharm., CXLIV, 238; J. pr. Chem., CIV, 56; Zeitschr. Chem., 1867, 522; Bull. soc. chim. [2], VIII, 417; Zeitschr. anal. Chem. VII, 252; Chem. News, XVI, 232.
1867	Ed. Becquerel		Etudes chim. sur quelq. métaux, Paris, 1867.
1867	Pinner	Cyanides	De uranylio cyan. et rhodan. Berlin, Inaug. Dissert., 1867.
1867	Rammelsberg	Phosphites	Pogg. Ann. CXXXIII, 500.
1868	Merz	Fluorescence	J. pr. Chem. CI, 261; C. C. 1868, 99.
1868	Péligot and Valenciennes.	Manufacture of the metal.	C. R. LXVII, 507; Ann. Ch. Pharm., CCXLIX, 128; C. C., 1869, 1040; Dingl. pol. J., CXC, 305; J. pr. Chem. CVI, 255; Jahresb., chem. Techn., 1868, 152; Jahresb., 1868, 226; Instit. 1868, 306; Ann. chim. phys. [4], XVII, 368; Zeitschr. Chem. 1868, 716.
1869	Heintz	Recovery of residues	Ann. Ch. Pharm., CLI,, 216. Am. J. Sci. [2], L, 113. Jahresb., 1869, 286; Chem. News, XX, 166.
1869	Thalèn	Wave lengths of light rays	Nova acta Reg. Soc. Sc. Upsal. [3], VI. Ann. chim. phys. [4], XVIII, 239.
1869	Reichardt	Separation from phosphoric acid.	Zeitschr. anal. Chem., VIII, 116; Chem. News, XX, 167; Am. J. Sci. [2] L, 113; Zeitschr. Chem., 1870, 92; Archiv der Pharm. [3], II, 232; Jahresb., 1869, 916.
1869	Bolton	Action of light; historical summary and experiments.	Am. J. Sci. [2], XLVIII, 206; Jahresb., 1869. 1176; Chem. News, XX, 213.
1869	Winkler	Estimation; a correction	Zeitschr. anal. Chem., VIII, 387; C. C., 1870, 530; Jahresb., 1869, 916; Chem. News, XXI, 167.
1869	Byasson	Estimation of phosphoric acid.	Pharm. Centralh., IX, 41; Russ. Zeitschr. Pharm., VIII, 30; Jahresb., 1869, 977.
1869	Selhorst	Non-fluorescence of U salts in Geissler tubes.	Rev. hebd. chim., Dec. 2, 1869; Chem. News, XX, 299.
1869	Thudichum	Absorption spectrum	Centralbl. f. med. Wissensch., 1869, 1; C. C., 1869, 67; J. pr. Chem., CVI, 415.
1870	Bolton	Index to the literature of U.	Annals. Lyc. Nat. Hist., IX, 362; Am. Chem., I, 81.
1870	Sorby	Absorption spectrum of compounds of Zr and U.	Chem. News, XXI, 73; Zeitschr. anal. Chem., IX, 258; C. C., 1870, 369; Ber. d. chem. Ges., 1870, 147; Bull. soc. chim., XIV, 40.
1870	Meyer, L	Atomic weight	Ann. Chem. Pharm., Suppl., VII, 354; Jahresb., 1870, 14.
1870	Schwarz	Coloring porcelain	Dingl. pol. J., CXCVII, 251; Pol. Notizbl., 1870, 290; C. C., 1870, 557; Jahresb., 1870, 1155; Jahresb. chem. Techn., 1870, 306.
1870	Schultz-Sellack	Hydrated nitrate	Zeitschr. Chem., 1870, No. 19; Chem. News, XXIII, 47.
1870	Mendelejeff	At. wt. and position of U in the Periodic System.	N. Petersb. Acad. Bull., XVI, 45; Ber. d. chem. Ges., 1870, 991; Ann. Chem. Pharm., Suppl., VIII, 178; Jahresb., 1871, 312.
1870	Bolton	Extraction from uraninite.	Am. Chem., I, 50.
1871	Schultz-Sellack	Disulphate	Ber. d. chem. Ges., 1871, 13; Am. J. Sci. [3], I, 374; Am. Chem., I, 469.
1871	Schultz-Sellack	Basicity of oxide	Ber. d. chem. Ges., IV, 12; J. Chem. Soc. [2], IX, 199; Bull. soc. chim., XV, 45; C. C., 1870, 87; Jahresb., 1871, 332; Chem. News, XXIII, 131.

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1871	Jani	U solution in titration of P_2O_5.	C. C., 1871, 329; J. Chem. Soc. [2], IX, 753.
1871	Jani	Recovery of residues	C. C., 1871, 219; J. Chem. Soc. [2], IX, 586; Am. Chem., I, 472; Jahresb., 1871, 331; Chem. News, XXIII, 220; Zeitschr. anal. Chem., XI, 71.
1872	Hagenbach	Fluorescence of U glass	Pogg. Ann., CXLVI, 393.
1872	Schumann	Estimation of phos. acid	J. pr. Chem, [2], VI, 416; Jahresb., 1872, 896.
1872	Brachet	Use of U glass in electrical illumination.	C. R., XXII, No. 16; Am. Chem., II, 191.
1872	Taylor	As sensitizer in photography.	Ber. d. chem. Ges., 1872, 820.
1872	Jean	Blow-pipe test	San Francisco Sc., XXIII, 13; Berg- und hütten-Ztg., XXX, 414; C. C., 1872, 213.
1872	Bolton	Tetrethylammonium U	Am. Chem., II, 456; Jahresb., 1872, 259.
1872	Rammelsberg	Uranous acetates with copper, and with cobalt.	Pogg. Ann., CXLV, 158; Jahresb., 1872, 259; Bull. soc. chim. [2], XVII, 209; J. Chem. Soc. [2], X, 401; Am. Chem., II, 431.
1872	Rammelsberg	Formulæ when U = 240	Ber. d. chem. Ges., 1872, 1003; Jahresb., 1872, 257; Bull. soc. chim., XIX, 210; J. Chem. Soc., 1873, 247; C. C., 1873, 127; Am. Chem., IV, 148; Chem. News, XXVII, 22.
1872	Bolton	Thallium uranate	Am. Chem., II, 456; Jahresb, 1872, 255.
1872	Follenius	Titration with potassium permanganate.	Zeitschr. anal. Chem., XI, 179; Jahresb., 1872, 915; J. Chem. Soc., 1873, 531; C. C., 1872, 600.
1872	Becquerel	Fluorescence	C. R., LXXV, 296; Am. J. Sci. [3], IV, 486; Ann. chim. phys. [4], XXVII, 539; Jahresb., 1872, 152; C. C., 1873, 17.
1872	Rammelsberg	Hypophosphite	J. Chem. Soc., 1873, 11; Ber. d. chem. Ges., 1872, 495.
1873	Lockyer	Occurrence in the sun	Ber. d. chem. Ges., 1873, 1554; Proc. Roy. Soc., XXI, 285 and 508; Jahresb., 1873, 153.
1873	Gibbs	Arseniate	Ber d. chem. Ges., 1873, 834.
1873	Kreusler	Recovery of residues	J. für Landw., 1873, 1; Am. Chem., IV, 316.
1873	Joulie	Use in estimating phosphoric acid.	Chem. News, XXVII, 228, 309, 314; Jahresb., 1873, 922.
1873	Clarke, F. W	Specific gravity of compounds.	Constants of Nature, Washington, D. C., 1873.
1873	Reichardt	Separation from phosphoric acid by means of magnesia mixture.	Arch. der Pharm. [3], 2, 232; Jahresb., 1873, 924; Jour. Chem. Soc., 1873, 1260; Zeitschr. anal. Chem., XIII, 310; C. C., 1873, 356; Am. Chem., IV, 276; Chem. News, XXVIII, 315.
1873	Cronander	Chloride of U and P	Ber. d. chem. Ges., VI, 1466; Bull. soc. chim., XIX, 499; Jahresb. reinen Ch., 1873, 25.
1873	Schnauss	Use of nitrate in photography.	Archiv der Pharm., Nov., 1873; Jahresb., 1873, 1130.
1873	Gautier	Hypophosphite	C. R., LXXVI, 49; Jahresb. reinen Ch., 1873, 25.
1873	Patera	Commercial and industrial	Jahresb. chem. Tech., 1875, 609.
1873	Kitchin	Est. of P as uranic phosphate, and At. Wt.	Chem. News, XXVII, 199; Jahresb. reinen Ch., 1873, 71; Jahresb., 1873, 921; Bull. soc. chim., XX, 177.
1873	Abesser, Jani, and Märcker.	Use in estimating phosphoric acid.	Zeitschr. anal. Chem., XII, 254; Jahresb., 1873, 919.
1873	Morton and Bolton	Fluorescent and absorption spectra.	Am. Chem., III, 361 and 401; also IV, 1, 41, and 81; Chem News, XXVIII, 47, 113, 164, 233, 244, 257, 268; Jahresb. reinen Ch., 1873, 72; J. Chem. Soc. [2], XII, 12 and 642; Monit. scient. [3], 963; Zeitschr. anal. Chem., XII, 308; Jahresb., 1873, 158; C. C., 1873, 593; Bull. soc. chim., XXI, 63.
1873	Gibbs	Separation from Cr	Am. J. Sci. [3], V, 110; Chem. News, XXVIII, 63; Jahresb., 1873, 937; J. Chem. Soc., 1873, 98; Zeitschr. anal. Chem., XII, 310; C. C., 1873, 281; Bull. soc. chim., XX, 175.
1874	Roscoe	Pentachloride	Ber. d. ch. Ges., VII, 1131; Bull. soc. chim., XXIII, 270; C. C., 1874, 657; Jahresb., 1874, 284; Jahresb. reinen Ch., 1874, 115; J. Chem. Soc. [2], XII, 933; Am. Chem., V, 304, and V, 234; Chem. News, XXXI, 32.

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Date.	Author.	Remarks.	References.
1874	Böttger	Action of P on solutions of U.	Jahresb. phys. Ver., Frankft., 1872–1873, 14; C. C., 1874, 322.
1874	Morton	Fluorescent relations of basic salts.	Monit. scient., IV, 318; Chem. News, XXIX, 17; Jahresb. reinen Ch., 1874, 116.
1874	Jean	Use in estimation of phosphoric acid.	C. R., LXXVIII, 1305; Ber. d. chem. Ges., 1874, 737; Jahresb., 1874, 973.
1874	Hartley	Influence of heat on absorption spectra.	Chem. News, XXIX, 148; Ber. d. chem. Ges., 1874, 740; Proc. Lond. Roy. Soc., XXII, 241; Jahresb., 1874, 96.
1875	Isambert	Precipitation of Ag by oxide.	C. R., LXXX, 1087; Bull. soc. chim., XXIV, 368; Ber. d. chem. Ges., 1875, 697; J. Chem. Soc., 1875, 1164; Chem. News, XXXI, 239; Zeitschr. anal. Chem., XIV, 346; Jahresb., reinen Ch., 1875, 82; Jahresb., 1875, 223.
1875	Nilson	Selenites	Researches on salts of Selenious Acid; Nova acta Reg. Soc. Scient. Upsala [III], 1875; Ber. d. chem. Ges., 1875, 655; Bull. soc. chim. [2], XXIII, 497; Jahresb., 1875, 163.
1875	Bolton	Separation from Vd	Am. Chem., V, 363; C. C., 1876, 809; Bull. soc. chim., XXVII, 295; Jahresb., 1875, 223.
1875		Production of U in Prussia, 1869 to 1873.	C. C., 1875, 528.
1875	Atterberg	Ferrocyanides	Bull soc. chim., XXIV, 355; Jahresb., 1875, 235; Ber. d. chem. Ges., 1876, 856.
1875	Mann	Utilization of bye-products in U manufacture.	C. C., 1875, 83; J. Chem. Soc., 1875, 1303.
1875	Maxwell Lyte	Use in titration of zinc	Chem. News, XXXI, 222; Zeitschr. anal. Chem., XIV, 343.
1875		Value of metal	San Francisco Sc.: Berg- u. hütten-Ztg., XXXIV, 244; C. C., 1875, 544.
1875	Fairley	Uranic acid, $UO_4 2H_2O$	Chem. News, XXXII, 219; Bull. soc. chim. XXI, 553; J. Chem. Soc., 1876, 192; Jahresb., 1875, 223; Jahresb. reinen Ch., 1875, 82, and 1876, 6; C. C., 1876, 130; Ber. d. chem. Ges., 1876, 948; Am. Chem., VI, 316.
1875	Bolton	Price of metal	Am. Chem., V, 443.
1876	Belohoubek	Use in titration of phosphoric acid.	Sitzungsb. k. böhm. Ges., 1876, H. 4; Zeitschr. anal. Chem., XVI, 104.
1876	Vogel	Absorption spectra	Ber. d. chem. Ges., VIII, 1533; Zeitschr. anal. Chem., XV, 329; Dingl. pol. J., CCXIX, 535; Jahresb. reinen Ch., 1875, 462.
1876	Kern	Reagent for U. (Ferrocyanide soluble in HCl.)	Chem. News, XXXIII, 5; Jahresb., 1876, 1002; J. Chem. Soc., 1876, 741; Zeitschr. anal. Chem., XVI, 238: Jahresb. reinen Ch., 1876, 86, and 1877, 106.
1876	Kern	Action of Mg on salts of U.	Chem. News, XXXIII, 236; Jahresb., 1876, 236.
1876	Gawalovski	Recovery of U residues	Zeitschr. anal. Chem., 1876, 292; C. C., 1876, 775; Jahresb., 1876, 270; J. Chem. Soc., 1877, 345.
1876	Wyrouboff	Formula of U ferrocyanide	Ann. chim. phys. [5], VIII, 444; Jahresb., 1876, 311; C. C., 1876, 691; Jahresb. reinen Ch., 1876, 81.
1876		Production of U ores in 1874.	C. C., 1876, 415, and 31.
1876	Naudin and de Montholon.	Action of CO_2 on U cyanide.	Ber. d. chem. Ges., 1876, 1433.
1876	Lupton	Succinate	Chem. News, XXXIII, 90; Bull. soc. chim., XXVI, 362.
1876	Fairley	Tetroxide and peruranates.	J. Chem. Soc., 1877, I. 127; Jahresb., 1877, 297; Chem. News, XXXIII, 237.
1877	Ditte	Separation from Fe and Cr.	C. R., LXXXV, 281; Ann. chim. phys. [5], XII, 135; Jahresb., 1877, 1057; J. Chem. Soc., 1877, II, 926; Chem. News, XXXVI, 100; Zeitschr. anal. Chem., XVII, 96; Bull. soc. chim., XXX, 414; C. C., 1877, 631 and 712; Dingl. pol. J., CCXXVII, 412; Jahresb. reinen Ch., 1877, 102.
1877	Strohmer and Klaus	Recovery of U residues	Dingl. pol. J., CCXXV, 561; Jahresb., 1877, 1057; C. C., 1877, 744; J. Chem. Soc., 1878, 114; Zeitschr. anal. Chem., XVII, 84; Jahresb. reinen Ch., 1877, 106 and 1878, 109.
1877	Brügelmann	Estimation of P and As acids.	Zeitschr. anal. Chem., XVI, 22; J. Chem. Soc., 1877, 741; Dingl. pol. J., CCXXIV, 558.
1877		Production of ores in Austria in 1875.	C. C., 1877, 128.
1877	Fresenius	Criticism on Kern's reagent for U.	Zeitschr. anal. Ch., XVI, 238; Jahresb. reinen Ch., 1877, 106.
1877	Sendtner	Researches	Verbind. des Urans, Erlangen, 1877.
1877	Patera	Report on technical processes.	Hofmann's Entwick. der chem. Industrie, 836; Jahresb., 1877, 1121.

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1878	Lockyer	Occurrence in the sun	Lond. R. Soc., Proc., XXVII, 279; LXXXVI, 317; Jahresb., 1878, 185.
1878	Burcker	Separation from iron	C. C., 1878, 453; Dingl. pol. J., 230, 96; Jahresb., 1878, 1060; J. pharm. chim. [4], XXVII, 347; J. Chem. Soc., 1878, 2, 771; Zeitschr. anal. Chem., XIX, 350; Jahresb. reinen Ch., 1878, 109; Chem. News, XXXVIII, 276.
1878	Lommel	Fluorescence of U glass	Ann. Phys. [2], III, 113; Jahresb., 1878, 162.
1878	Bolton	Decomposition of uraninite by citric acid.	Ann. N. Y. Acad. Sci.; Chem. News, XXXVII, 99; Jahresb., 1878, 1198; Zeitschr. anal. Chem., XIX, 60; Mineral. Mag. Apr. 1881.
1878	Luckow	Electrolytic separation	Zeitschr. anal. Chem., XIX, 9 and 18.
1878	Vincent	Action of dimethylamine on U solutions.	Bull. soc. chim., XXXIII, 156; Zeitschr. anal. Chem., XIX, 479; C. C., 1880, 279.
1878	Patera	Separation of Vd. in U ores.	Oest. Ztschr. f. Berg - u. Hüttenwesen, 1878, 2 and 13; Dingl. pol. J., CCXXXI, 556.
1878	Priwoznik and Schneider.	Composition of commercial sodium uranate.	Berg - und hüttenm. Jahrbuch, 1878, 208; Dingl. pol. J., CCXXVIII, 379 and 556; Jahresb. reinen Ch., 1878, 109; Jahresb. chem. Tech., 1879, 531.
1878	Böttger	Action of P on solutions	C. C., 1878, 208.
1879	Donath	Specific heat of oxides	Ber. d. chem. Ges., 1879, 742; Jahresb., 1879, 91; Wien. Acad. Ber. [2], 1879, 699; J. Chem. Soc., 1879, 2, 688; C. C., 1879, 387, and 1880, 227 Jahresb. reinen Ch., 1879, 97, and 1880, 101.
1879	Sendtner	Selenates, selenites, and bromides.	Ann. Chem., CXCV, 325; J. Chem. Soc., 1879, 2, 507; C. C., 1879, 275; Jahresb. reinen Ch., 1879, 97; Bull. soc. chim., XXXII, 181.
1879	Zimmermann	Separation from Fe	Ann. Chem., CXCIX, 1; Chem. News, XL, 273; Jahresb., 1879, 1051; J. Chem. Soc., 1880, 2, 189; Zeitschr. anal. Chem., XX, 414; Bull. soc. chim., XXXIV, 713; Ber. d. chem. Ges., XII, 2254.
1879	Vogel	Absorption spectrum of nitrate.	J. Chem. Soc., 1879, 189; Ber. d. chem. Ges., XI, 913.
1879	Ditte	Action of fuming HNO_3 on U nitrate.	C. R., Oct. 13, 1879; Ber. d. chem. Ges., XII, 2270.
1880	Schucht	Electrolytic behavior	Chemikerztg., 1880, 292; Berg- u. hüttenm. Ztg., XXXIX, 121; Jahresb., 1880, 174.
1880	Smith, E. F	Electrolysis of acetate	Am. Chem. J., I, 329; Ber. d. chem. Ges., 1880, 751; Jahresb., 1880, 174; Zeitschr. anal. Chem., XXI, 260; Jahresb. reinen Ch., 1880, 102.
1880	Chastaing	Behavior of U. salts with alkaline pyro-and metaphosphates.	Bull. soc. chim. [2], XXXIV, 20; Jahresb., 1880, 353; C. C., 1880, 564; Jahresb. reinen Ch., 1880, 101; Ber. d. chem. Ges., XIII, 1860.
1880	Zimmermann	Sulphide; uranium red	Ann. Chem., CCIV, 226; Ber. d. chem. Ges., XIII, 2078; Bull. soc. chim., XXXV, 176; Chem. News, XLIII, 153; J. Chem. Soc., 1881, II, 79; Zeitschr. anal. Chem., XX, 557; C. C., 1880, 40 and 756; Jahresb. reinen Chem., 1880, 102; Jahresb., 1880, 351.
1880	Ditte	Fluorides and oxyfluorides.	C. R., XCI, 115 and 166; Ber. d. chem. Ges., XIII, 1977; Jahresb. chem. Techn., 1880, 408; Chem. News, XLII, 82 and 95; J. Chem. Soc., 1880, II, 853 and 794; C. C., 1880, 625; Dingl. pol. J., CCXXXVIII, 504; Jahresb. reinen Chem., 1880, 101; Jahresb., 1880, 353.
1880	Clarke and Owens	Monochloracetate of U and Na.	Am. Chem. J., II, 331; Ber. d. chem. Ges., XIV, 35; Bull soc. chim., XXXVI, 441; C. C., 1881, 197; J. Chem. Soc., 1881, II, 1124; Jahresb. reinen Ch., 1880, 102 and 1881, 97; Jahresb., 1880, 764.
1880	Luckow	Estimation by electrolysis.	Ztschr. anal. Chem., 1880, 1; Chem. News, XLI, 213, Jahresb., 1880, 1139; Jahresb. reinen Ch., 1880, 2; Jahresb. chem. Tech., 1880, 411.
1880	Schucht	Estimation by electrolysis.	C. C., 1880, 374; Jahresb., 1880, 1143; Dingl. pol. J., CCXXXIX, 303 and 378.
1880	Schicht	Estimation by electrolysis.	Chem. News, XLI, 280; Jahresb., 1880, 1143.
1880	Zimmermann	Action of uranyl salts on turmeric paper.	Ann. Chem., CCIV, 224; Jahresb., 1880, 1184; J. Chem. Soc., 1881, 2, 122; Zeitschr. anal. Chem., XX, 415; C. C., 1880, 756; Chem. News, XLIII, 153; Ber. d. chem. Ges., XIII, 2093.
1880	Lallemand	Technical working of ores.	Monit. scient. [3], X, 965; Jahresb. reinen Ch., 1880, 103; Chem. News, XLIII, 72.

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Date.	Author.	Remarks.	References.
1880	Baker	Isomorphism of fluorine compounds.	Ann. Chem., CCII, 234.
1881	Zimmermann	At. wt. based on density of gaseous compounds (chlorides).	Ber. d. chem. Ges., 1881, 1934; Jahresb., 1881, 4; J. Chem. Soc., 1882, 2, 143; C.,C., 1881, 676; Jahresb. reinen Ch., 1881, 97; Bull soc. chim., XXXVII, 350; Ber. d. chem. Ges., XIV, 1935 *b*.
1881	Clarke	Recalculation of at. wt	Smithsonian Misc. Coll., 441, 150; Phil. Mag. [5], XII, 101; Am. Chem. J., III, 363; Jahresb., 1881, 6; Chem. News. XLIX, 112.
1881	Zimmermann	Alkaline uranates	Ber. d. chem. Ges., 1881, 440; Jahresb., 1881, 292; J. Chem. Soc., 1881, 2, 686; C. C., 1881, 298; Dingl. pol. J., CCXL, 326; Jahresb. reinen Ch., 1881, 97; Jahresb. chem. Tech. 1881, 376.
1881	Reinsch	Detection by the microscope.	Ber. d. chem. Ges., 1881, 2325; Jahresb., 1881, 1183.
1881	Brauner	Specific vol. of oxide	Phil. Mag. [5], XI, 60; J. Chem. Soc., 1881, 2, 219.
1881	Zimmermann	Titration with $K_2 Mn_2 O_8$	Ber. d. chem. Ges., XIV, 779; Jahresb. reinen Ch., 1881, 90.
1882	Zimmermann	At. wt. determination based on specific heat of metal.	Ber. d. chem. Ges., 1882, 847; Jahresb., 1882, 16; Dingl. pol. J., CCXLIV, 334; Jahresb. chem. Tech., 1882, 178; Bull soc. chim., XXXVIII, 266.
1882	Zimmermann	Uranyl compounds and researches; metallic U, estimation, &c.	Ann. Chem., CCXIII, 285; Jahresb., 1882, 327; J. Chem. Soc., 1882, 2, 1260; Zeitschr. anal. Chem., XXIII, 63 and 220; Ber. d. chem. Ges., XV, 2617.
1882	Ditte	Crystallized uranates	C. R., XCV, 988; Jahresb., 1882, 330; J. Chem. Soc., 1883, 2, 296; Chem. News, XLVI, 290; Bull soc. chim., XXXIX, 520.
1882	Wiesner	Chromates of Uranyl and K.	Chem. Centr., 1882, 777; Anz. d. böhm. naturf. Versamml. Jahresbericht, 1882, 332; J. Chem. Soc., 1883, 2, 425.
1882	Lecoq de Boisbaudran.	Separation from gallium	Compt rend., XCIV, 1154; Chem. News, XLV, 207; Jahresb., 1882, 1294.
1882	....	Statistics	Jahresb. chem. Tech., 1882, 223.
1883	Smithells	Fluorides	Chem. Soc. J., XLIII, 125; Jahresb., 1883, 385; Chem. News, XLVII, 44; Ber. d. chem. Ges., XVI, 955.
1883	Savory	Recovery of residues, and separation from phosphoric acid by tin.	Chem. News, XLVIII, 251; Jahresb., 1883, 385; J. Chem. Soc., 1884, 397.
1883	Gibbons	Oleate	Pharm. J. Trans. [3], XIII, 737; J. Chem. Soc., 1883, 2, 692; Monit. scientif., Sept., 1883; Chem. News, XLVIII, 182.
1883	Zimmermann	Reactions of U.; preparation of metal.	Ann. Chem., CCXVI, 10; Zeitschr. anal. Chem., XXIII, 66; Jahresb. chem. Tech., 1883, 219; Chem. News, XLVII, 130, and L, 67; Bull soc. chim., XXXIX, 599; Ber. d. chem. Ges., XVI, 388.
1884	Ditte	Fluorides and uranates	Ann. chim. phys. [6], 1, 338; J. Chem. Soc. 1884, 825.
1884	Classen	Separation from Zn. and Cr. by electrolysis.	Ber. d. chem. Ges. XVII, 2483; Chem. News, LI, 220.
1885	Regelsberger	Ammoniacal compounds of uranyl chloride.	Ann. Chem. CCXXVII, 119.
1885	Rammelsberg	Double acetates	Ann Phys. Jan. 15, 1885.
1885	Blüncke	Specific heat	Ann. Phys. Jan. 15, 1885.
1885	Casamajor	Blowpipe reaction with silver iodide.	Chem. News., LII, 1.

MINERALS.

ABBREVIATIONS.—A., Autunite; G., Gummite; T., Torbernite; **Ur., Uraninite.**

Date.	Author.	Mineral.	References.
1727	Brückmann	Schwarz Beckerz	Magn. Dei, 204.
1747	Wallerius	Beckblände	Wall. Min., 249.
1758	Cronstedt	Swartblende	Cronst. Min., 198.
1772	De Born	Pechblende, Mica viridis cryst.	Lithophyl. Born., 133.
1780	Werner	Grüner Glimmer	Ueb. Cronst., 217.

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1785		Grüner Glimmer	Mém. acad. sci. Paris, 1785, 238; Crell's Ann. 1791, II, 152.
1787	Klaproth	Uranerz	Mem. Akad. Berl., 1787, 160.
1739	Klaproth	Uranit Spath	Schr. Ges. N. Berl., IX, 273.
1789	Klaproth	Analysis Ur	Crell's Ann. 1789, II, 400; Klap. Beitr., II, 221.
1789	Werner	Chalcolith	Bergm. J., 376.
1789	Werner	Pecablende	Bergm. J.
1790	Klaproth	Analysis Ur	J. de phys., XXXVI, 248.
1792	Anonymous	Analysis Ur	J. de phys., XLII, 241.
1793	Karsten	Torberite	Ueb. Wern. Verbess., 43.
1800	Karsten	Pecherz	Karst. Min. Tabell., 56.
1800	Champeaux	Uranite	Phil. Mag., 1800, 185.
1801	Haüy	Urane oxidulé	Haüy Traité.
1802	Sage	Analysis Ur	Phil. Mag., 1802; J. de phys., LV, 314.
1802	Ekeberg	Discovery of P_2O_6 in T	Ann. ch. phys. [1], XLII, 233.
1803	Ludwig	Uranglimmer	Ludwig. Min., I, 55.
1805	Gregor	Analysis T	Phil. Trans., 1805; Ann. Phil. V, 281; Ann. Phil. VII, 63; Nicholson's J., XIII, 247.
1807	Brunner	Occurrence	Leonh. Tasch. I, 362.
1808	Vauquelin	Uraninite	Ann. ch. phys. [1], XLVIII, 277.
1809	Bernhardi	Crystallographic, Uranglimmer.	Leonh. Tasch., III, 95.
1814	Aikin	Uranite	Mineralog. Manual, 1814.
1817	Werner	Feste Uranokker	Wern. Min. Syst., 26; Hoffm. Min., IX a 279.
1818	Phillips	Uranite	Trans. Geol. Soc., III; Ann. Phil. XII, 133.
1818	Freiesleben	Lichtes Uranpecherz	Beitr. Min. Kennt. Sachs., 187; Leonh. Tasch. XII, 168,
1819	Berzelius	Urankalk	N. Syst. Min., 295; Ann. chim. phys. [2], XIII, 31; Schweigg. J., XXVII, 74; Ann. Phil. XIII, 464.
1820	Jameson	Uranmica	Min. Syst., 1820.
1820	Breithaupt	Uranphyllit	Charak. d. Min. Syst.
1821	John	Uranvitriol	Chem. Unters., V, 254.
......	Berzelius	Zippeite	Schweigg. J., XXXII., 245. Leonh. Tasch., XVI, 693; Ann. Phil., XXIV, 390.
1822	Phillips	Torbernite	Ann. Phil., XX, 469.
1822	Pfaff	Analysis Ur	Schweigg. J., XXXV, 326.
1822	Berzelius	Hydrate	Ann. ch. phys. [2], XII, 31; Berz. Jahresb., I, 89.
1823	Berzelius	Analysis T	Berz. Jahresb., 1823, 137.
1823	Berzelius	Analysis A., Chalcolite	Pogg. Ann., I., 374; Schweigg. J., XLIV, 29; Edinb. J. Sci., II, 372; Ann. Phil., XXV, 274.
1823	Phillips	Presence of P_2O_5 in T	Ann. Phil., N. S., VI, 156.
1823	Phillips	Analysis T	Ann. Phi. [2], V, 57; Am. J. Sci. [1], VII, 380; Schweigg. J., XLIV, 42.
1823	Laugier	Analysis A	Ann. ch. phys. [2], XXIV, 239.
1824	Zippe	Uranblüthe	Verh. Ges. Böhm. Prag., 1824; Leonh. Zeitschr., XX, 168; Edinb. J. Sci., V, 185.
1827	Zippe	Uranblüthe	Kastner's Arch. Nat., XII, 252; Berz. Jahresb., VIII, 198.
1830	Haidinger	Johannite	Abh. Böhm. Ges. Prag., 1830; Edinb. J. Sci. N. S., III, 306; Berz. Jahresb., XI, 208.
1832	Beudant	Uraconise	Beud. Traité, II, 672.
1832	Breithaupt	U. Gummierz	Charak. Min. Syst., 218.
1833	Kersten	Gummite	Pogg. Ann., XXVI, 492; Schweigg. J., LXV, 18; Ann. Ch. Pharm., VIII,, 285.
1834	Kersten	Uranpecherz	Pogg. Ann., XXVI, 491; Berz. Jahresb., XIII, 165; Ann. Ch. Pharm., VIII, 285.
1836	Gerhardt	Uranpecherz	J. pr. Ch., IV, 54.
1837	Breithaupt	Uranerz	J. pr. Ch., XII, 184.
1839	Rose, G	Uranotantalite	Pogg., Ann. XLVIII, 555; Edinb. N. Phil. J., XXIX, 418.
1841	Breithaupt	Uranochalcite	Breith. Handb. Min., 173.
1843	Ebelmen	Analysis Ur	Ann. d. M. [4], IV, 400; Ann. ch. phys. [3], VIII, 498; Berz. Jahresb., XXIV, 304; J. pr. Ch., XXX, 414.
1844	Rammelsberg	Analysis Ur	Pogg. Ann., LIX, 35; Berz. Jahresb., XXIV, 304; Jahrb. f. Min., 1884, 353.
1845	Teschemacher		Am. J. Sci. [1], XLVIII, 395.
1845	Shepard		Am. J. Sci. [1], XLVIII, 395.
1845	Haidinger	Uranin	Handb. best. Min., 549.
1845	Haidinger	Zippeit	Handb. best. Min., 510.
1847	Rose H	Samarskite	Pogg., LXXI, 157.
1847	Breithaupt	Schwer Uranerz	Handb., 1847, 863.
1847	Breithaupt	Urangummi	Handb., 1847, 863.
1847	Breithaupt	U. Pittinerz	Handb., 1847, 863.

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1848	Scheerer, Th	Analysis Ur	Pogg., Ann., LXXII, 570; N. Jen. Lit. Ztg., 1848, 55.
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1848	Hermann	Yttroilmenite	J. pr. Ch., XLIV, 216.
1848	Smith, J. L	Medjidite	Am. J. Sci. [2], V, 337; XI., 259; Ann Ch. Pharm, LXVI, 254: Jahresb., 1847–48, 1220.
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1852	Haidinger	Eliasite	Jahrb. geolog. Reichs., IV, 124.
1852	Vogl	Liebigite, Voglite	Jahrb. geolog. Reichs., IV, 221; Jahresb., 1853, 849.
1853	v. Hauer	Analysis of Uranpecherz	Jahrb. geolog. Reichs., 1853, 105; and 1854, 186; J. pr. Ch., LXI, 391; Pharm. Centr., 1854, 334; Jahresb., 1854, 793; Jahrb. Min., 1855, 76.
1853	Chapman	Uranatemnite	Chap. Pract. Min., 148.
1853	Ragsky	Pittinerz	Pogg. Ann., Ergänz., IV, 348.
1854	Dauber	Basic sulphate	Pogg. Ann., XCII, 251.
1855	Fritsche	Uranpecherz	B. u. H. Ztg., 1855, 111; Jahrb. Min., 1855, 445.
1856	Descloizeaux	Optical exam. of minerals	Ann. mines [5], XI, 261; Am. J. Sci. [2], XXV, 396; Instit., 1857, 49; C. R., XLIV, 322; Jahresb., 1857, 687.
1857	Vogl	Basic sulphate	Min. Joach. Teplitz., 1857.
1857	Lindacker	Uranochalcite, Zippeite &c.	Am. J. Sci. [2], XXV, 414; Min. Joach., 1857, 95 and 119; Jahresb., 1857, 694.
1857	Descloizeaux	Autunite	Ann. d., XIV, 377; Jahrb. Min., 1861, 184,
1857	Genth	Analysis of Coracite	Am. J. Sci. [2], XXIII, 421; J. pr. Ch., LXXIII, 206; Jahresb., 1857, 663.
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1859	Ordway	Basic sulphate	Am. J. Sci. [2], XXVI, 197; J. pr. Ch., LXXVI, 23.
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1860	Websky		Jahrb. Min., 1860, 810.
1861	Pisani	Analysis A	C. R., LII, 817; Jahresb. 1861, 1030; Rép. chim. pure, III, 222; J. pr. Ch., LXXXV; Jahrb. Min., 1862, 601.
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1865	Church	Analysis T	Chem. News., XII, 183; Jahresb., 1865, 911.
1866	Church	Autunite	J. Chem. soc., 1866, 135.
1868	Websky	Kochelite	Jahrb. Min., 1868, 607; Jahresb., 1868, 1013.
1869	Hermann	Samarskite and related minerals.	J. pr. Ch., CVII, 139.
1870	Websky	Uranophane	Zeitschr. geol. Ges., XXII, 92; Jahresb., 1870, 1304.
1870	Boricky	Uranotile	Jahrb. Min., 1870, 780; Jahresb., 1870, 1305; Ber. d. chem. Ges., 1870, 307.
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1870	Zepharowich	Crystallographic, uranotile	Jahrb. Min., 1870, 780; Jahresb., 1870, 1305.
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1872	Weisbach	Silicate	Jahrb. Min., 1872, 316; Jahresb., 1872, 1123.
1872	Maskelyne & Flight.	Uranite	Chem. Soc. J. [2], X, 1054; Jahresb., 1872, 1136; Ber. d. chem. Ges., V, 990; C. C., 1873, 118.
1872	Nordenskjϕld	Nohlite	Geol. För. Forhandl. Stockholm, I, 7; Jahrb. Min., 1872. 534.
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1873	Schrauf	Uranotile	Min. Mitth., 1873, 138; Jahresb., 1873, 1179.
1873	Wibel	Autunite	Jahrb. f. Min., 1873, 242; J. Chem. Soc., 1873 1110.
1873	Winkler	Uranosphärite, Trögerite, Zeunerite, Uranospinite.	J. pr. Chem. [2], VII, 1; Jahrb. Min., 1873, 870; Jahresb., 1873, 1190; C. C., 1873 342; Am. Chem., IV, 36; J. Chem. Soc., 1873, 606; Jahresb. reinen Ch., 1873, 72; Chem. News, XXVII, 307, and XXVIII, 227; Bull. soc. chim., XX, 171.
1873	Frenzel	Torbernite, Autunite and Zeunerite.	Jahrb. Min., 1873 946.

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1877	Kerr	Occurrence of U. minerals in North Carolina.	Am. J. Sci. [3], XIV, 496.
1877	Winkler	Uranocircite	J. pr. Chem. [2], XVI, 91; Zeitschr. Kryst., I, 394; Jahresb., 1877, 1302; J. Chem. Soc., 1878, II, 17; C. C., 1877, 646; Jahresb. reinen Ch., 1877, 107.
1877	Church	Uranocircite, estimation of water.	Min. Mag., I, 234; Zeitschr. Kryst., III, 113; Jahresb. reinen Ch., 1879, 98.
1877	Weisbach	Crystallographic	Zeitschr. Kryst., I, 394; Jahrb. Min., 1877, 406; Jahresb., 1877, 1303.
1878	Nordenskjøld	Cleveite and Yttrogummite.	Geol. För. Förh., IV, 28.
1878	Brush and Dana	Uraninite	Am. J. Sci. [3], XVI, 35.
1878	Roster	Uranite in Elba	Jahrb. f. Min., 1877, 531; J. Chem. Soc., 1878, 2, 280.
1878	Reichardt	Uraninite from Joachimsthal.	Arch. Pharm. [3], XIII, 130; J. Chem. Soc., 1879, 2, 18; Jahresb. reinen Ch., 1878, 109.
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1880	Comstock	Uraninite from Branchville, Conn.	Am. J. Sci. [3], XIX, 220; Ztschr. Kryst., IV, 615; Jahrb. Min., 1881, Ref., II, 171; Jahresb., 1880, 1413; C. C., 1880, 314; Jahresb. reinen Ch., 1880, 103.
1881	Collier	Uranothorite	Am. J. Sci. [3], XXI, 161; Ztschr. Kryst., V, 514; Jahresb., 1881, 1361; J. Chem. Soc., 1881, 2, 1009; Bull. soc. min. France, V, 117.
1881	Hidden	Uraninite in North Carolina.	Am. J. Sci. [3], XXII, 22; J. Chem. Soc., 1881, 2, 1110; Zeitschr. Kryst., VI, 517.
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1884	Blomstrand	Mineral from Moss, Norway, and on the occurrence of natural uranates. Bröggerite.	Geol. För. Förhandl, Stockholm, VII, 59; J. pr. Chem. [2], XXIX, 191; J. Chem. Soc., 1884, 1102; Chem. News, L, 104; Am. chim. phys. [6], IV. 129.
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KEY TO ABBREVIATIONS.

[Dates following titles indicate works fully indexed.]

Abbreviations.	Fuller title.
Am. Chem	American Chemist. Chandler. New York. 1870–'77.
Am. Naturalist	American Naturalist. Philadelphia.
Am. J. Photog	American Journal of Photography. New York.
Am. J. Sci	American Journal of Science. Silliman & Dana. New Haven. 1818–'85.
Ann. Ch. Pharm. *or* Ann. Chem	Annalen der Chemie und Pharmacie; *and* Liebig's Annalen der Chemie. Heidelberg. 1832'–'85.
Ann. ch. phys	Annales de chimie (et de physique). Paris. 1789–1884.
Ann. d. M	Annales des mines. Paris.
Ann. Phys	Annalen der Physik und Chemie Wiedemann. Berlin. 1877–'84.
Annals Lyc. Nat. Hist	Annals of the New York Lyceum of Natural History.
Annals N. Y. Acad. Sci	Annals of the New York Academy of Sciences. New York. 1877–'84.
Annuaire chim	Annuaire de chimie. Millon et Reiset. Paris. 1845–'51.
Anz. d. böhm. naturf. Versamml	Anzeiger der böhmischen naturforschender Versammlung.
Archiv der Pharm	Archiv der Pharmacie, des allg. deutschen Apotheker-Vereins.
B. & M. Min	Introduction to mineralogy. Brooke & Miller. London.
Ber. d. chem. Ges	Berichte der deutschen chemischen Gesellschaft. Berlin. 1868–'84.
Berg- und hüttenm. Ztg	Berg- und hüttenmännische Zeitung. Leipzig.
Bergm. J	Bergmännisches Journal. Köhler. Freiberg.
Berz. Jahresb	Jahresbericht über die Fortschritte der physischen Wissenschaften. Berzelius. 1822–'51.
Breith. Handb. Min	Vollständiges Handbuch der Mineralogie. A. Breithaupt. Leipzig.
Brit. J. Phot	British Journal of Photography. Liverpool.
Buchner's Report	Repertorium für die Pharmacie. Buchner. Nürnberg.
Bull. belge photog	Bulletin belge de la photographie. Bruxelles.
Bull. des sci	Bulletin des sciences, publié par la Société philomathique de Paris.
Bull. soc. chim	Bulletin de la Société chimique de Paris. 1864–'85.
Bull. soc. min. France	Bulletin de la Société minéralogique de France.
Bull. soc. nat. Moscou	Bulletin de la Société Impériale des naturalistes de Moscou.
Bull. soc. philomath	Bulletin de la Société philomathique. Paris.
C. C	Chemisches Centralblatt. Leipzig. 1850–'84.
Chap. Pract. Min	Practical Mineralogy. E. J. Chapman. London.
Charak. d. Min. Syst	Charakteristik des Mineral-Systems. Breithaupt. Freiberg.
Chem. Gaz	Chemical Gazette. London.
Chem. News	Chemical News. Crookes. London. 1860–'85.
Chem. techn. Mittheil	Chemisch-technischen Mittheilungen. Elsner.
Chem. Unters	John's Chemischer Untersuchungen mineralischer * * * Substanzen. Berlin.
Chemiker Ztg	Chemiker-Zeitung. Köthen.
Cosmos	Cosmos. Moigno. Paris.
Crell's Ann	Chemische Annalen. Crell. 1784–1803.
Cronst. Min	Mineralogie. Cronstedt. Stockholm.
Dingl. pol. J	Polytechnisches Journal. Dingler. Stuttgart. 1820–'85.
Gehlen's J	Neues allgemeines Journal der Chemie. Gehlen.
Geol. För. Förhandl. Stockholm	Geologiska Förening, Förhandlingar. Stockholm.
Génie industr	Génie industriel. Paris.
Gilbert Ann	Annalen der Physik. Gilbert. 1799–1824.
Gött. gelehrt. Anz	Göttingische gelehrte Anzeigen. Göttingen.
Handb. best. Min	Handbuch der bestimmenden Mineralogie. Haidinger. Wien.
Hauy, Traité	Traité de minéralogie. Hauy. Paris. 1801.
Horn's Photog. J	Photographisches Journal. Horn. Leipzig.
Humphrey's J	Humphrey's Journal of the Daguerreotype. New York.
Instit	L'Institut. Paris.
J. Chem. Soc	Journal of the Chemical Society of London. 1849–'85.
J. für. Landw	Journal für Landwirthschaft. Göttingen.
J. pr. Ch	Journal für praktische Chemie. Leipzig. 1834–'84.
Jahrb. geolog. Reichs	Jahrbuch der k. k. geologischen Reichsanstalt. Wien.
Jahrb. Min	Jahrbuch für Mineralogie. Leonhard & Bronn.
Jahresb	Jahresbericht über die Fortschritte der reinen, pharmaceutischen und technischen Chemie. Liebig und Kopp. Giessen. 1847–'84.
Jahresb. chem. Tech	Jahresbericht über die Fortschritte der chemischen Technologie. Wagner. Leipzig. 1855–'84.
Jahresb. phys. Ver. Frankft	Jahresberichte der physikalischen Verein zu Frankfurt a. M.
Jahresb. reinen Ch	Jahresbericht über die Fortschritte auf dem Gebiete der reinen Chemie. Tübingen. 1873–'82.
Journ. de pharm	Journal de pharmacie (et de chimie). Paris. 1815–'84.
Journ. de phys	Journal de physique, de chimie [etc.]. La Méthérie. Paris.
Karst. Min. Tabell	Mineralogische Tabellen. Karsten. 1800.
Kastner's Arch. Nat	Archiv für die gesammte Naturlehre. K. W. G. Kastner, Nüremberg.

Key to abbreviations—Continued.

Abbreviations.	Fuller title.
Kong. Vet. Acad. Handl	Kongl. Vetenskaps Akademien Handlingar. Stockholm.
Leonh. Taschenb	Taschenbuch für die gesammte Mineralogie. Leonhard. Frankfurt a. M.
Lithophyl. Born	Lythophilacium Bornianum. Prag.
Liverpool Phot. J	Liverpool Photographic Journal.
Ludwig Min	Handbuch der Mineralogie nach Werner. Ludwig.
Magn. Dei	Magnalia Dei in locis subterraneis. Brückmann.
Mém. Acad. roy. sci. Berlin	Mémoires de l'Académie royale des sciences de Berlin.
Mem. Chem. Soc. Lond	Memoirs and Proceedings of the Chemical Society of London. 1841–'48.
Min. Joach. Teplitz	Ganguerhältnisse und Mineralreichthum Joachimthals. J. Fl. Vogl. Teplitz. 1857.
Min. Mag	Mineralogical Magazine and Journal. Truro. 1876–'84.
Min. Syst	Jameson's System of Mineralogy. Edinburgh.
Min. Mitth	Mineralogische Mittheilungen. H. Tschermak. Wien.
Mineralog. Manual	Aikin's Manual of Mineralogy. London.
Monatsb. d. Berl. Acad	Monatsberichte der kön. Academie der Wissenchaften. Berlin.
Mondes, Les	Les Mondes. Moigno. Paris.
Monit. photog	Moniteur de la photographie. Paris.
Monit. scient	Moniteur scientifique. Quesneville.
N. Arch. ph. nat	Archives des sciences physiques et naturelles. Nouvelle Série. Genève.
N. Gegenst. der Ch	Ueber die neueren Gegenstände in der Chemie. J. B. Richter. Breslau.
N. Petersb. Acad. Bull	Bulletin de l'Academie impériale des sciences de St.-Pétersbourg.
N. Syst. Min	Nouveau système de minéralogie. Berzelius. Paris.
Nicholson's J	A Journal of Natural Philosophy, Chemistry [etc.]. Wm. Nicholson. London. 1797–1813.
Nova acta Reg. Soc. Sc. Upsal	Reg. societat. scient. upsaliensis, nova acta. Upsala.
Oestr. Zeits. Berg- u. Hütt	Oesterreichische Zeitschrift für Berg- und Hüttenwesen.
Pharm. Centr	Pharmaceutisches Centralblatt. Leipzig. 1830–'49.
Pharm. Centralh	Pharmaceutische Centralhalle für Deutschland. Berlin.
Phil. Mag	Philosophical Magazine. London. 1798–1884.
Phil. Trans	Philosophical Transactions of the Royal Society. London.
Pogg. Ann	Annalen der Physik und Chemie. Poggendorff. Berlin. 1824–84.
Polyt. Centr	Polytechnisches Centralblatt. Leipzig.
Polyt. Centralhalle	Polytechnische Centralhalle. Leipzig.
Polyt. Notizbl	Polytechnisches Notizblatt. Böttger. Mainz.
Preuss. Zeitschr. Berg-H. u. Salin	Preussische Zeitschrift für das Berg-, Hütten- und Salinenwesen.
Proc. Acad. Nat. Sci. Philad	Proceedings of the Academy of Natural Sciences. Philadelphia.
Proc. Chem. Soc. Lond	Proceedings of the Chemical Society of London. 1843.
Quart. J. Sci	Quarterly Journal of Science. Royal Institution. London.
Ramm. Handb	Handbuch der Mineralchemie. Rammelsberg.
Rép. chim. appl	Répertoire de chimie appliquée. Paris.
Rép. chim. pur	Répertoire de chimie pure. Paris.
Repert. Arts	Repertory of Arts, Manufactures [etc.]. London.
Repert. Pat. Inv	Repertory of Patent Inventions. London.
Revue hebd. chim	Revue hebdomadaire de chimie. Méne. Paris.
Russ. Zeitschr. Pharm	Russische Zeitschrift für Pharmacie. St. Petersburg.
San Francisco Sc	San Francisco Scientific and Mining Press.
Schriften berl. Ges. naturf. Fr	Schriften der berlinischen Gesellschaft naturforschender Freunde. Berlin.
Schweigg. J	Journal für Chemie und Physik. J. S. C. Schweigger. Nürnberg. 1811–'33.
Sitzungsb. k. böhm. Ges	Sitzungsberichte der kön. böhmischen Gesellschaft der Wissenschaften. Prag.
Smithsonian Misc. Coll	Smithsonian Miscellaneous Collections.
Technologiste	Le Technologiste. Paris.
Trans. Roy. Soc. Edinb	Transactions of the Royal Society of Edinburgh.
Trommsd. J. der Pharm	Journal der Pharmacie. Trommsdorff. Leipzig.
Wall. Min	Mineralogia. Wallerius. Stockholm.
Wien Acad. Ber	Sitzungsberichte der math.-naturwiss. Classe der kais. Academie der Wissenschaften. Wien.
Wiener polyt. J	Wiener polytechnisches Journal.
Zeitschr. anal. Ch	Zeitschrift für analytische Chemie. Fresenius. Wiesbaden. 1862–'84.
Zeitschr. Ch	Zeitschrift für Chemie. Göttingen.
Zeitschr. Pharm	Kritische Zeitschrift für Chemie.
Zeitschr. ges. Naturw	Zeitschrift für die gesammte Naturwissenchaften.
Zeitschr. Kryst	Zeitschrift für Krystallographie und Mineralogie. Groth. Leipzig. 1877–'84.

[For full titles and bibliographical details of the above consult: Catalogue of Scientific Serials, by S. H. Scudder, Cambridge, 1879, and: Catalogue of Scientific and Technical Periodicals, 1665–1882. by Henry Carrington Bolton, Washington, D. C, 1885.]

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